REPORT OF THE RIVER MASTER OF THE DELAWARE RIVER

FOR THE PERIOD DECEMBER 1,1990-NOVEMBER 30, 1991

By Stanley P. Sauer, William E. Harkness, And Bruce E. Krejmas

With a section on WATER QUALITY

By Kirk E. White

U. S. GEOLOGICAL SURVEY
Open File Report 93-459

Reston, Virginia

1993

U.S. DEPARTMENT OF THE INTERIOR
BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY
Robert M. Hirsch, Acting Director

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U.S. Geological Survey
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Reston,VA 22092
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CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To Obtain
	Length	
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
	Area	
square mile (mi^2)	2.590	square kilometer
	Volume	
million gallons (Mgal)	3,785	cubic meter
million gallons (Mgal)	1.547	cubic foot per second-day
billion gallons (Bgal)	3.785	cubic hectometer
cubic foot per second-day	0.002447	cubic hectometer
	Flow	
million gallons per day (Mgal/d)	1.547	cubic foot per second
million gallons per day (Mgal/d)	0.04381	cubic meter per second
billion gallons per day (Bgal/d)	1547	cubic foot per second
cubic foot per second (ft^3/s)	0.02832	cubic meter per second

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 - - a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

Section I

RIVER MASTER LETTER OF TRANSMITTAL

and

SPECIAL REPORT

- PAGE 3 FOLLOWS -

OFFICE OF THE DELAWARE RIVER MASTER
United States Geological Survey
433 National Center, Reston, Virginia 22092

June 21, 1993

The Honorable
William H. Rehnquist
Chief Justice of the Supreme Court
of the United States

The Honorable
Thomas R. Carper
Governor of Delaware

The Honorable
James J. Florio
Governor of New Jersey

The Honorable
Mario M. Cuomo
Governor of New York

The Honorable
Robert P. Casey
Governor of Pennsylvania

The Honorable
David N. Dinkins
Mayor of the City of New York

New Jersey v. New York et al
No. 5 Original, October Term 1950

Dear Sirs:

For the record and in compliance with the provisions of the Amended Decree of the Supreme Court of the United States entered June 7, 1954, I am transmitting herewith the thirty-eighth Annual Report of the River Master of the Delaware River for the year December 1, 1990, to November 30, 1991.

Precipitation in the upper Delaware River basin during the 1991 River Master report year ranged from 179 percent of the long-term average during December to 47 percent during June (table 1). Total precipitation during the year was 5.31 inches below average. Precipitation during the December to May period, when reservoirs typically refill, was only slightly below average. However, almost one third of the precipitation occurring during the period was in December.

On December 1, 1990, when this report year began, combined storage in the New York City reservoirs in the upper Delaware River Basin was 223 billion gallons (Bgal), 82 percent of the combined storage capacity. Median storage on December 1, based on 23 years of data, is 161 Bgal.

During the December through May period, storage in the New York City reservoirs usually increases in response to lower demand for water and to higher base flows in the streams in the basin. During the 1991 report year, storage increased during December, in response to the above-normal precipitation, but declined steadily during January and early February. On February 7, the storage began a steady increase reaching a maximum of 270.468 Bgal, combined storage for the report year on May 10, 1991 when Pepacton and Cannonsville were spilling. On June 1, 1991, the start of the water-operations year, storage was 261.447 Bgal which was 8.747 Bgal below the median.

The Delaware River Master Advisory Committee met at Port Jervis, New York on May 31, 1991 to discuss hydrologic conditions in the basin and operational procedures for the 1991 release season. As River Master, I informed the committee that, on the basis of information provided by New York City, the excess quantity to be released beginning June 15 was 7.381 Bgal. This water would be released at rates designed to maintain the Montague target flow at 100 ft^3/s above the normal 1,750 ft^3/s specifed by the Decree. The New York State representative requested that the Parties to the Decree consider setting aside the excess-release quantity for the year because the basin had received below-normal precipitation for the previous five months and the seasonal drawdown of the reservoirs had started about one month earlier than normal. After a lengthy discussion, the Parties agreed that conditions were below normal, but it did not warrant suspending the excess quantity at that time. However, they also agreed to monitor the hydrologic conditions in the basin closely and if it appeared that conditions were approaching drought levels, the request would be reconsidered.

On July 18, 1991 the Parties to the Decree, the Delaware River Basin Commission and the River Master unanimously agreed to suspend the release of the remaining portion of the excess-release quantity in order to conserve water in the New York City Reservoirs. At the time the excess-release was suspended, 2.482 Bgal out of the total quantity of 7.381 Bgal had been released.

On September 8, 1991 the storage in the New York City reservoirs declined into the drought-warning zone of the operation curves for the reservoirs and operations based on the "Interstate Water Management Recommendations of the Parties to the Supreme Court Decree" began. During the remainder of the report year, the Parties to the Decree, the Delaware River Basin Commission and the River Master met on numerous occasions either in person or by conference call to discuss hydrologic conditions in the basin and to modify the operative plan to cope with the water supply shortage in the basin caused by the drought. Details of the operations are discussed in Section II of this report.

On November 30, 1991, the end of this report year, the combined storage in the New York City reservoirs was 107.766 Bgal, 39.8 percent of capacity and the operations in the basin were being conducted per the plan established by the "Interstate Water Management Recommendations of the Parties to the Decree" as modified by unanimous agreement.

During the report year, the River Master and staff participated in meetings of the Delaware River Basin Commission to assess water-supply conditions. Upon invitation of the representatives of the Parties to the Decree, the Deputy Delaware River Master met periodically with those representatives as a member of the Flow Management Technical Advisory Committee. Discussions primarily centered on proposals for the management of releases from reservoirs in the basin and other measures designed to cope with streamflow deficiences whenever they occur.

The U.S. Geological Survey continued the operation of its field office of the Delaware River Master at Milford, Pennsylvania. William E. Harkness, Deputy Delaware River Master, continued in charge of the office, assisted by Bruce E. Krejmas and Beverly A. Roberts.

Mr. Stanley P. Sauer, who served as Delaware River Master since January 1, 1987 retired from Federal service on March 12, 1993. Mr. Sauer very ably guided the operations of the office during the period this report covers and much of the time during preparation of this report. Following Mr. Sauer's retirement, I was designated by the Chief Hydrologist as Acting Delaware River Master until such time as selection of replacement can be made.

During the report year, the Milford office continued the weekly distribution of summary river data. These weekly reports contained preliminary data on releases from the New York City reservoirs to the Delaware River, diversions to the New York City water-supply system, reservoir contents, daily segregation of flow of the Delaware River at Montague gaging station, and diversions by New Jersey. The reports were made available to the State and City representatives on the Delaware River Master Advisory Committee and to other parties interested in the Delaware River operations. A special monthly summary of past hydrologic conditions, supplemented by an "outlook" of the river flow for the forthcoming month, was made available to the representatives on the Advisory Committee.

Section II of this report describes in detail Delaware River operations during the report year. As shown on page 17, the City of New York diverted a total of 262.087 Bgal from the basin during the report year ending November 30, 1991 and released 116.944 Bgal from Pepacton, Cannonsville, and Neversink Reservoirs to the Delaware River during the same period. The River Master directed releases to the Delaware River from these reservoirs totaling 100.921 Bgal.

Section III of this report describes water quality at various sites in the Delaware River Estuary. It was prepared by Kirk E. White, U.S. Geological Survey, Malvern, Pennsylvania and contains data showing the extent of salinity encroachment and other water-quality characteristics in the estuary.

During the report year, the following individuals functioned as members of the River Master Advisory Committee:

Delaware	Dr. Robert R. Jordan
New Jersey	Steven Nieswand
New York	Russell C. Mt. Pleasant
New York City	Albert F. Appleton
Pennsylvania	John E. McSparran

Throughout the year, diversions to supply water for New York City and releases designed to maintain the flow of the Delaware River at Montague were made as directed by this office. Diversions by New York City from the Delaware River basin reservoirs did not exceed the limit specified by the Decree or the limits in the several agreements among the Parties to the Decree.

The appreciation of the River Master and staff is expressed for the continued excellent cooperation of all the representatives of the Parties to the Decree. Also, appreciation is extended to the Pennsylvania Power & Light Company and the Orange and Rockland Utilities, Inc. for their cooperation in keeping us informed of their plans for power generation and resulting releases as requested by this office. As usual, it is gratifying to report that New York City complied willingly with the terms of the Decree and with the directives of the River Master. New Jersey also cooperated fully with the directives of the River Master concerning their diversions from the basin.

A draft of this report was furnished to the Advisory Committee members for comment.

Sincerely yours,

William E. Harkness

William E. Harkness, P.E.
Acting Delaware River Master

Section II

REPORT OF DELAWARE RIVER OPERATIONS

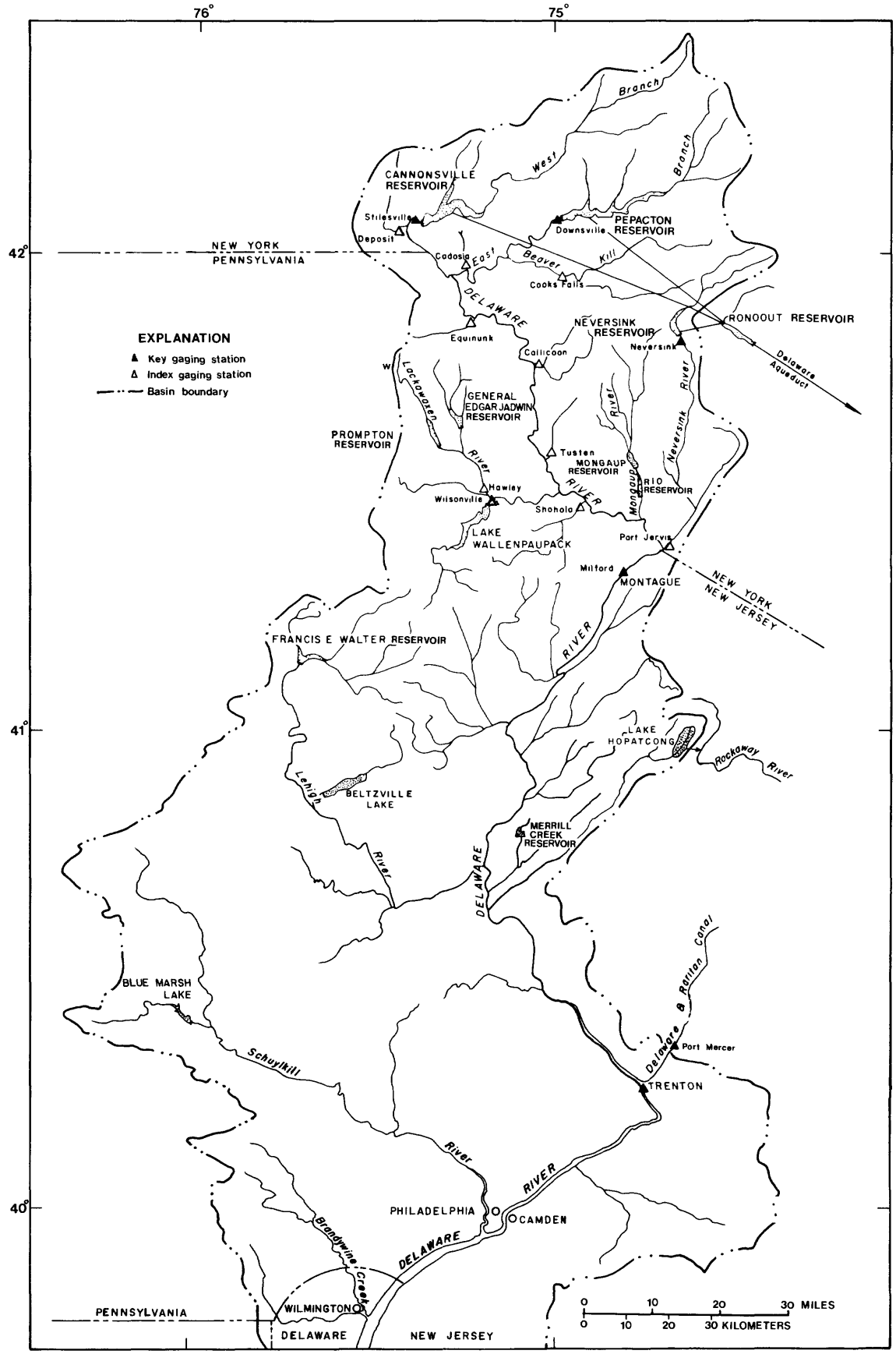

Figure 1. - Delaware River Basin upstream from Wilmington, Delaware.

Section II

REPORT OF DELAWARE RIVER OPERATIONS

by William E. Harkness and Bruce E. Krejmas

ABSTRACT

A Decree of the Supreme Court of the United States in 1954 established the position of Delaware River Master. The Decree authorizes diversions of water from the Delaware River basin (fig. 1) and requires compensating releases from certain New York City owned reservoirs to be made under the supervision and direction of the River Master. Reports to the Court, not less frequently than annually, were stipulated.

During the 1991 report year, December 1, 1990 to November 30, 1991, the monthly precipitation and runoff ranged from above average to below average in the Delaware River basin. For the year as a whole, precipitation was 5.31 inches below average. Reservoir storage in the basin increased during December, declined in January, then increased steadily throughout the winter months. Operations were conducted as prescribed in the Decree until July 18 when in response to the unanimous request of the Parties to the Decree, the excess-release quantity was suspended to conserve the short water supplies. Hydrologic conditions in the basin entered drought-warning on September 13 and remained in drought-warning for the remainder of the year.

Diversions from the Delaware River basin by New York City and New Jersey did not exceed those authorized by the terms of the Amended Decree, or the reduced limits imposed to combat the drought. Releases were made as directed by the River Master at rates designed to meet the Montague flow objective on 172 days during the year. Releases were made at the augmented conservation rates, at rates designed to relieve thermal stress in the streams downstream from the reservoirs or at other times at the basic conservation rates.

New York City and New Jersey complied fully with the terms of the Decree, the agreements reached to conserve water in the basin during the drought, and with the directives of the River Master during the year.

INTRODUCTION

The Amended Decree of the United States Supreme Court entered June 7, 1954 authorized diversions of water from the Delaware River basin and provided for releases of water from certain New York City reservoirs to the Delaware River to be made under the supervision and direction of the River Master. The Decree also stipulated that reports be made to the Court not less frequently than annually. This report describes the River Master operations from December 1, 1990 to November 30, 1991.

Part of the hydrologic data presented are records of flow and water quality at U.S. Geological Survey gaging stations. These records were collected, computed, and furnished by the Offices of the U.S. Geological Survey at Albany, New York, Malvern, Pennsylvania, and West Trenton, New Jersey, in cooperation with the States of New York and New Jersey, the Commonwealth of Pennsylvania, and the City of New York.

Definitions of Terms and Procedures

The following definitions apply to various terms and procedures used in the operations described in this report. A table for converting inch-pound units to International System of Units (SI) is given on page v. The map of the Delaware River basin (fig. 1) indicates the location of pertinent streams, reservoirs, and gaging stations.

Time of day. - Time of day is expressed in 24-hour eastern standard time, which included a 23-hour day April 7 and a 25-hour day October 27.

Rate of flow. - Mean discharge for any stated 24-hour period, in cubic feet per second (ft^3/s) or million gallons per day(Mgal/d).

Rate of flow at Montague. - Daily mean discharge of the Delaware River at Montague, N.J., on a calendar-day basis.

Reservoir-controlled releases. - Controlled releases from reservoirs passed through outlet valves in the dams or through turbines in powerplants. This does not include spillway overflow at the reservoirs.

Uncontrolled runoff at Montague. - Runoff from the drainage area upstream from Montague exclusive of the drainage area upstream from the Downsville, Cannonsville, Neversink, Wallenpaupack, and Rio dams but including spillway overflow at these dams.

Point of maximum reservoir depletion. - Elevation at the top of the highest outlet, sometimes referred to as minimum full-operation level.

Storage or contents. - Usable volume of water in a reservoir. Unless otherwise indicated, volume is computed on the basis of level pool and above the point of maximum depletion.

Capacity. - Total usable volume between the point of maximum depletion and the elevation of the lowest crest of the spillway.

Diversions. - The transfer of water by New York City from Pepacton, Cannonsville, and Neversink Reservoirs in the upper Delaware River Basin through the East Delaware, West Delaware, and Neversink Tunnels, respectively, to its water-supply system. Also, the transfer of water by New Jersey from the Delaware River through the Delaware and Raritan Canal.

Excess quantity and seasonal period for its release. - As defined in the Decree, the excess quantity of water equals 83 percent of the amount by which the estimated consumption in New York City during the year is less than the City's estimate of continuous safe yield (1,655 Mgal/d stipulated by 1954 Decree) from all its sources of supply obtainable without pumping, except that the excess quantity should not exceed 70 billion gallons. Each year the "seasonal period" for release of the excess quantity begins on June 15. The design rate for that period becomes effective at Montague on that date and continues in effect until the following March 15, or until the cumulative total of excess-release credits becomes equal to the seasonal quantity, whichever occurs first.

Daily excess-release credits. - Daily credits and deficits during the seasonal period are equal to the algebraic difference between the daily mean discharge at Montague and 1,750 ft^3/s; however, the daily credit cannot exceed the 24-hour period releases from Pepacton, Cannonsville, and Neversink Reservoirs routed to Montague and made in accordance with direction, with the following exception. During the seasonal period, credits are also made for part or all of other releases from these reservoirs contributing to daily mean discharge at Montague between the excess-release rate and 1,750 ft^3/s.

Precipitation

Precipitation measured in the basin above Montague totaled 37.90 inches for the 1991 report year and was 5.31 inches below the long-term average. Monthly precipitation ranged from 179 percent of the long-term average in December, 1990 to 47 percent of the average in June 1991. Table1 compares the monthly precipitation during the report year with the long-term average.

Table 1. - Precipitation in inches,
Delaware River basin upstream from Montague, N.J.

Month	December 1940 to November 1990 Monthly Average	December 1990 to November 1991			
		Amount	Percentage of average	Excess (+) or deficit (-) Month	Cumulative
December	3.33	5.97	179	+2.64	+2.64
January	2.89	2.20	76	-.69	+1.95
February	2.75	1.73	63	-1.02	+.93
March	3.22	3.57	111	+.35	+1.28
April	3.73	2.98	80	-.75	+.53
May	4.31	3.33	77	-.98	-.45
June	3.93	1.83	47	-2.10	-2.55
July	4.13	2.42	59	-1.71	-4.26
August	3.98	3.22	81	-.76	-5.02
September	3.72	3.43	92	-.29	-5.31
October	3.40	3.16	93	-.24	-5.55
November	3.82	4.06	106	+.24	-5.31
12 months	43.21	37.90	88	-5.31	

These data were computed from records collected by the National Weather Service, New York City Department of Environmental Protection, Bureau of Water Supply and the River Master, at ten stations distributed over the basin area upstream from Montague.

December to May is generally considered the normal time of year when surface- and ground-water reservoirs fill. During this period in 1990-91, precipitation totaling 19.78 inches was observed, which was 98 percent of the 50-year average; however almost one third of that occurred during December. During June to November, 18.12 inches of precipitation was observed, which was 79 percent of the long-term average. The maximum monthly precipitation received during the year for any of the ten stations was 7.73 inches in December at Callicoon, New York; the minimum monthly precipitation observed was 0.88 inches in June also at Callicoon, New York.

Acknowledgments

The River Master daily operation records were prepared by the Milford Office of the Delaware River Master from hydrologic data collected principally on a day-to-day basis. Data for these records were collected and computed by the Milford office or were furnished by agencies as follows: Data from Pepacton, Cannonsville, and Neversink Reservoirs by the New York City Department of Environmental Protection, Bureau of Water Supply; from Delaware and Raritan Canal by the New Jersey Water Supply Authority; from Lake Wallenpaupack by the Pennsylvania Power & Light Company; and from Rio Reservoir by Orange and Rockland Utilities, Inc. Precipitation data and quantitative precipitation forecasts were provided by the National Oceanic and Atmospheric Administration, National Weather Service.

OPERATIONS

December through May

During the first half of the report year, precipitation was 0.45 inches below average and ranged from 179 percent of the long-term average in December to 63 percent in February (table 1.) Runoff in the upper basin was above normal during December and was below normal during April and May.

On December 1, 1990, Pepacton Reservoir contained 106.900 Bgal of water in storage above the point of maximum depletion, or 76.3 percent of the reservoir's storage capacity of 140.190 Bgal. Cannonsville Reservoir contained 87.349 Bgal, or 91.3 percent of the reservoir's storage capacity of 95.706 Bgal and Neversink Reservoir contained 29.092 Bgal, or 83.3 percent of the reservoir's storage capacity of 34.941 Bgal. The combined storage in the three reservoirs as of December 1 was 223.341 Bgal, or 82.5 percent of their combined capacity. Daily storages in Pepacton, Cannonsville, and Neversink Reservoirs are shown in tables 10, 11, and 12, respectively, and the combined storage is shown graphically in figure 2.

Operations on December 1, 1990 were being conducted as prescribed by the Decree. The Montague flow objective was 1,850 ft^3/s and the allowable diversions to New York City and New Jersey were 800 Mgal/d and 100 Mgal/d, respectively. The average diversion to New York City since June 1, 1990 was 766 Mgal/d. Conservation releases from New York City reservoirs were being made at the augmented levels shown in table 2.

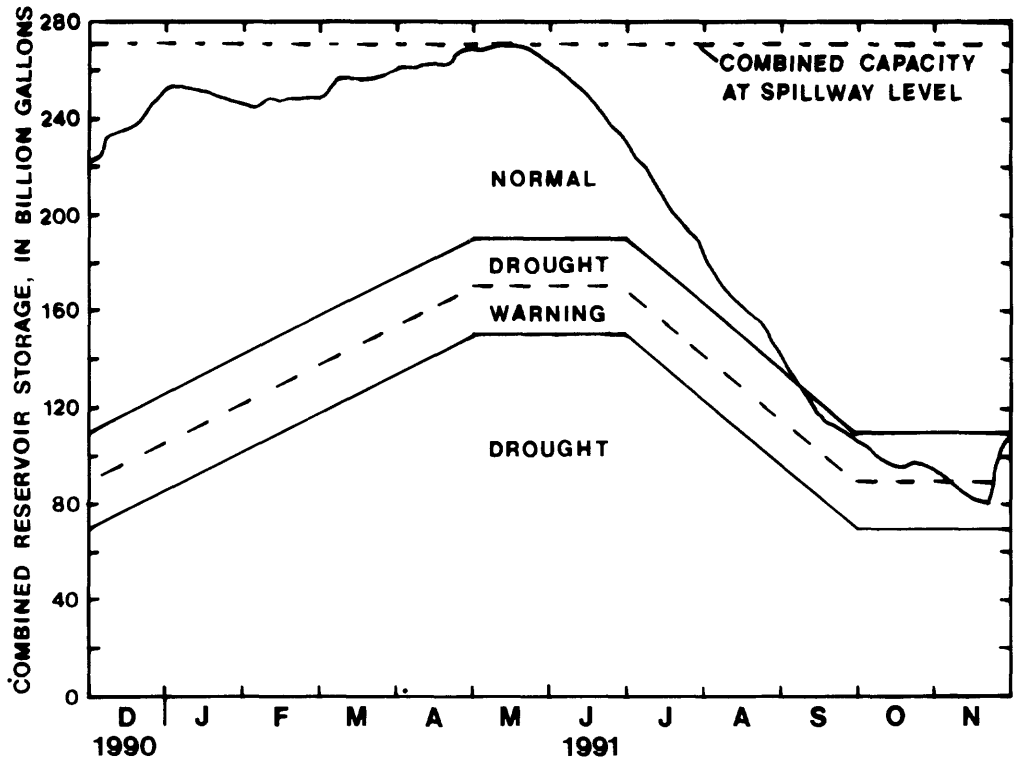

Figure 2. - Operating curves for New York City reservoirs in the Delaware River basin compared with the actual contents of the reservoirs, December 1, 1990 to November 30, 1991 (Sources: Operating curves from Interstate Water Management Recommendations of the Parties to the U. S. Supreme Court Decree of 1954, reservoir contents from New York City Bureau of Water Supply data.)

Table 2. - Conservation release rates for New York City Delaware River basin reservoirs

Reservoir	Operative dates	Conservation release rates	
		Basic (ft^3/s)	Augmented (ft^3/s)
Neversink	April 1-7	5	45
	April 8 to October 31	15	45
	November 1 toMarch 31	5	25
Pepacton	April 1-7	6	70
	April 8 to October 31	19	70
	November 1 to March 31	6	50
Cannonsville	April 1-15	8	45
	April 16 to June 14	23	45
	June 15 to August 15	23	325
	August 16 to October 31	23	45
	November 1-30	23	33
	December 1 to March 31	8	33

Inflow to the City's reservoirs during the December through May period generally exceeds draft rates and therefore increases storage. The average inflow to Pepacton, Cannonsville, and Neversink Reservoirs for these six months during the 50-year period, December 1940 to May 1990, was 300.4 Bgal. During the corresponding six months of the current report year, inflow to the three reservoirs totaled 282.2 Bgal. Evaporation loss was not included in the computation. Storage in the three reservoirs increased from 223.502 Bgal on November 30, 1990 to 262.252 Bgal on May 31, 1991.

The maximum volume of water in storage in the reservoirs, as shown in figure 2, was 270.468 Bgal on May 10 when Pepacton and Cannonsville reservoirs were spilling. Pepacton Reservoir filled to capacity on April 29, 1991 and spilled a total of 3.27 Bgal from April 29 to May 16, 1991. Cannonsville Reservoir filled to capacity and began spilling on December 19, 1990 and spilled continuously until May 19, 1991. Approximately 74.6 Bgal spilled during the year. Neversink Reservoir filled to within 1.6 percent of capacity on May 27, but did not spill.

Diversions to Rondout Reservoir by New York City totaled 132.629 Bgal during the December 1 through May 31 period (729 Mgal/d). During this same period, the anticipated discharge at Montague, exclusive of water released from the City reservoirs, fell below the design rate on eight days, May 24-31, and releases were directed to meet the Montague flow objective. On five of these eight days, additional releases were made to relieve thermal stress on the fishery downstream from the reservoirs. A total of 985 $(ft^3/s)\cdot d$ (637 Mgal) of water was released for the relief of thermal stress during May. New York City made releases for conservation purposes at the augmented conservation rates shown in table 2 on all other days during the period.

There were 2 days during the December through May period when the observed discharge at Montague was less than the design rate (table 16). Both of these deficiencies were the result of difficulty in predicting the amount of runoff from anticipated rainfall during the three-day design period.

June through November

Precipitation during the June through November period was below average in all months except November. Precipitation during the period was 18.12 inches or 4.86 inches below the 50-year average (table 1).

Diversions to Rondout Reservoir June 1 to November 30 totaled 129.458 Bgal. Releases were directed to satisfy the Montague Formula on 164 days when the anticipated discharge at Montague exclusive of water released from the City reservoirs fell below the applicable design rate (table 3). Releases at augmented conservation rates or at rates designed to relieve thermal stress were made at other times from each reservoir by New York City between June 1 and September 13, 1991 and at the basic conservation rates September 14 to November 30. A total of 978 $(ft^3/s)\cdot d$ (0.632 Bgal) was released for the relief of thermal stress between June 1 and September 13.

Table 3.-Design rates for the Delaware River at Montague, N.J. gaging station, December 1, 1990 to November 30, 1991

Effective dates	Montague Design Rate (ft^3/s)
December 1, 1990 to March 14, 1991	1,850
March 15 to June 14	1,750
June 15 to July 20	1,850
July 21 to Sept. 15	1,750
Sept. 16 to Oct. 13	1,655
Oct. 14 to Nov. 6	1,100*
Nov. 7-9	1,500
Nov. 10-17	1,350
Nov. 18-30	1,100

*-Except for 32 hours on weekends during October which was 1,655 ft^3/s to support recreation in the upper Delaware River basin.

During June 1-14, the flow required to be maintained in the Delaware River at Montague was the minimum basic rate of 1,750 ft^3/s. The forecasted discharge, exclusive of releases from Pepacton, Cannonsville, and Neversink Reservoirs, was less than the design rate on 12 days during the period and releases were directed.

On June 15, the seasonal period for release of the excess quantity of water from the reservoirs began, and the design rate at Montague was increased to 1,850 ft^3/s. This rate was composed of the basic rate of 1,750 ft^3/s plus 100 ft^3/s of the required excess release.

The New York City Department of Environmental Protection, Bureau of Water Supply, furnished the River Master with the following advance data for the 1991 calendar year:

1. The estimated continuous safe yield from all the City's sources, obtainable without pumping, is 1,665 Mgal/d, or a total during the calendar year 1991 of 1.665 Bgal/d x 365 days = 607.725 Bgal.

2. The estimated consumption that the City must provide from all its sources of supply during the calendar year 1991 is 591.582 + 7.250 = 598.832 Bgal.

On the basis of the provisions of the Decree and the above data, the aggregate quantity of excess-release water was 83 percent of (607.725 - 598.832) or 7.381 Bgal. The Montague design rate during the excess release period beginning June 15, 1991, was computed as:

$$1{,}750\ ft^3/s + \frac{7.381\ \text{Bgal} \times 1{,}547\ (ft/s)^3/(\text{Bgal/d})}{120\ \text{days}} = 1{,}850\ ft^3/s$$

Data on consumption of water by the City of New York for each calendar year, beginning in 1950, are shown in table 17.

On July 18, 1991 the Parties to the Decree, the Delaware River Basin Commission and the River Master agreed to suspend release of the excess quantity in an effort to conserve water and attempt to avoid going into a drought in the basin. From July 21 to September 15, 1991, the design rate at Montague was 1,750 ft^3/s (table 3). During this period, the advance estimate of flow at Montague exclusive of releases from the New York City reservoirs was below the design rate on all but one day and releases were directed. Also, during this period, the observed flow at Montague fell below the design rate on 26 days. Of those 26 days, 5 days were within 2 percent and 9 more days were within 5 percent of the design rate.

On September 8, 1991 storage in the New York City reservoirs declined into the drought-warning zone of the operation curves (fig. 2). By September 13, the storage had remained in the drought-warning zone for 5 consecutive days, therefore per the "Flow Management Recommendations of the Parties to the Decree", the Montague design rate was reduced from 1,750 ft^3/s to 1,655 ft^3/s which became effective at Montague on September 16. In addition on September 13, the allowable diversions from the basin by New York City and New Jersey were also reduced to 680 Mgal/d and 85 Mgal/d respectively.

In response to the decreased diversions and releases and to approximately two inches of precipitation in the upper Delaware River Basin during the September 16-20, 1991 period, the rate of decline of storage in the New York City reservoirs decreased but storage continued to decline (fig. 2). By October 10, the storage had dropped to 99.274 Bgal, 36.7 percent of capacity. In a further effort to reduce the decline in storage, the Parties to the Decree and the Delaware River Basin Commission unanimously agreed to reduce the allowable diversions to New York City and New Jersey to 560 Mgal/d and 70 Mgal/d, respectively and to reduce the Montague design rate from 1,655 ft^3/s to 1,100 ft^3/s except for a 32-hour period on weekends during October to protect weekend recreational uses. The reductions in allowable diversions were put into effect on October 11, 1992 and the reduction in the Montague design rate became effective on October 14, 1991.

On October 23, 1991, the Parties to the Decree and the Delaware River Basin Commission modified the previous agreement to eliminate the higher Montague design rate on weekends. In addition, the agreement, which was put into effect on October 28, 1991, stated that the Montague and Trenton target flows would be based on the drought level flow objectives as stated in the "Flow Management Recommendations of the Parties to the Decree" (DRBC Resolution 83-13). This change did not have an immediate affect on the Montague design rate because the drought level flow target was 1,100 ft^3/s, the same as the design rate which was in effect at that time. However, on November 3 the salt front (250 mg/L chloride isochlor 7-day average) in the Delaware estuary advanced above river mile 82.9 which required the Montague design rate to be increased to 1,500 ft^3/s. This advancement of the salt front above river mile 82.9 was caused by abnormally high tides in the estuary October 30 to November 1, 1991.

On November 6, 1991 the Parties to the Decree, DRBC and the River Master met by conference call and agreed that, since the advancement of the salt front was probably a temporary condition as a result of the unusually high tides, the Montague design rate should be reduced to 1,350 ft^3/s, for the remainder of November in order to conserve water. This new design rate became effective with the design for November 10, 1991.

On November 15, 1991, the Parties to the Decree and DRBC met again and agreed to reduce the Montague design rate to 1,100 ft^3/s for the remainder of November. Following the meeting, they requested the River Master to implement the agreement. After some discussion, the River Master agreed to implement the agreement in the interest of conserving the short water supply in the New York City Reservoirs and the new design rate became effective at Montague on November 18.

During the period when reduced Montague design rates were in effect, September 16 to November 30, 1991, the advance estimate of flow at Montague, exclusive of releases from the New York City reservoirs was below the applicable design rate on all but 16 days and releases were directed. Also during that period, the observed flow fell below the design rate on 18 days. Of the 18 days that fell below the design rate, 2 days were within 2 percent and 8 more days were within 5 percent of the design rate.

The hydrographs of plate 1, show the total discharge at Montague; the portion derived from uncontrolled runoff downstream from the reservoirs; the portion contributed by the power reservoirs; and the portion contributed by Pepacton, Cannonsville, and Neversink Reservoirs. In analyzing the water budget at Montague, the uncontrolled runoff downstream from the reservoirs was computed as the residual of observed flow less releases from all reservoirs and therefore was subject to all the errors in observations, transit times, and routing of the several components of flow. All of these uncertainties are contained in the computed hydrograph of uncontrolled runoff.

Summary of Operations

From December 1, 1990, to November 30, 1991, diversions to Rondout Reservoir totaled 262.087 Bgal, and all releases from the New York City reservoirs to the Delaware River totaled 116.944 Bgal. In addition, a total of 77.883 Bgal spilled from the reservoirs during the year.

During the year, maximum storage in Pepacton Reservoir was 140.950 Bgal, on May 10, 1991. Maximum storage in Cannonsville Reservoir was 98.925 Bgal, on March 6. Maximum storage in Neversink Reservoir was 34.370 Bgal, on May 27. The maximum combined storage in the three reservoirs during the year was 270.468 Bgal, on May 10 when Pepacton and Cannonsville reservoirs were spilling.

Minimum combined storage in the reservoirs during the year was 80.682 Bgal on November 21, 1991. Minimum storage in Pepacton Reservoir was 51.019 Bgal (36.4 percent of capacity) on November 22, 1991. Minimum storage in Cannonsville Reservoir was 22.507 Bgal (23.5 percent of capacity) on October 13, 1991 and minimum storage in Neversink Reservoir was 4.651 Bgal (13.3 percent of capacity) on November 22, 1991.

On November 30, 1991, combined storage in the three reservoirs was 107.766 Bgal, or 39.8 percent of their combined capacity. During the year, combined storage decreased 115.736 Bgal, or 42.7 percent of capacity.

A resume' of the combined storage of the three reservoirs on the first day of the month June 1967 to November 1991 is shown in figure 4. Storage was above the median December to April, was below the median in May and June, and was below the 25th percentile July through September. On October 1 and November 1, the combined storage was the lowest for that date during the period of record.

SUPPLEMENTARY RELEASE FROM WALLENPAUPACK POWERPLANT

An agreement between Pennsylvania Power & Light Company and New York City provides for supplementary releases from Wallenpaupack hydroelectric powerplant if the Delaware River Basin Commission requests compensation for water consumed at the company's Martins Creek steam-electric generating station. Releases may be requested if the flow of the Delaware River at Trenton, N.J. is expected to be less than 3,000 ft^3/s for more than three consecutive days. No supplementary releases were requested during the year.

COMPONENTS OF FLOW, DELAWARE RIVER AT MONTAGUE, N.J.

The data and computations of the various components of flow formed the basic operational records required to carry out the River Master's specific responsibilities with respect to the Montague Formula during the report year. The operational record has two parts: the advance estimates of the daily average flow at Montague, exclusive of controlled releases from New York City's reservoirs (table 15) and the segregation of the daily average flow at Montague among its various source components (table 16).

Discharge of the Delaware River at Montague was composed of the following source components:

1. Controlled releases from Lake Wallenpaupack on Wallenpaupack Creek in the production of hydroelectric power.
2. Controlled releases from Rio Reservoir on Mongaup River in the pro - duction of hydroelectric power.
3. Runoff from the uncontrolled area upstream from Montague.
4. Controlled releases from Pepacton, Cannonsville, and Neversink Reservoirs of New York City.

The releases from the City's reservoirs necessary to maintain the applicable rate of flow at Montague was computed from the advance estimates of flow at Montague, exclusive of controlled releases from the City's reservoirs.

TIME OF TRANSIT

The average times for the effective transit of water from the various sources of controlled supply to Montague used for discharge routing during the 1991 report year are as follows:

Source	Hours
Pepacton Reservoir	60
Cannonsville Reservoir	48
Neversink Reservoir	33
Lake Wallenpaupack	16
Rio Reservoir	8

This schedule was developed from reservoir and powerplant operations and gaging-station records of prior years and was found generally suitable. At times, noticeable exceptions occur, for example, when a large release from Cannonsville Reservoir follows a small one, a large part of the release is expended in filling the channel en route, and the remainder may appear at Montague as much as 18 hours late. During the winter, the cold weather causes ice to form in the streams, which, together with the low streamflow, gradually increases the resistance to streamflow and lengthens the time of transit.

On several occasions, when large releases were directed following small ones, these releases were directed to begin from 9 to 12 hours earlier than normal to compensate for the expected increase in travel time. These adjustments were helpful in getting the directed releases to Montague within the appropriate time frame, but were not fully successful. Therefore, the observed Montague flow tended to be low on the first day that these releases were expected to arrive and to be high on the second or third day. The average of the observed flow for approximately three days when this procedure was used was usually close to the design rate.

SEGREGATION OF FLOW AT MONTAGUE

The River Master daily operation record of reservoir releases and daily segregation of flow among the various source components contributing to the flow of the Delaware River at Montague is shown in table 16. The arrangement of data conforms with the downstream movement of water from the various sources to Montague. A horizontal summation of data in the table is equivalent to routing the various contributions to Montague, using the schedule for travel time of water discussed previously. The uncontrolled runoff was computed by subtracting the contributions of the several other sources from the observed discharge at Montague.

COMPUTATION OF DIRECTED RELEASES

In the daily operations, it was necessary that the River Master utilize: (1) discharges computed from recorded or reported stream gage heights for various 24-hour periods without current information about changes in stage-discharge relations that might have occurred; (2) daily discharge from New York City's three reservoirs obtained from venturi meters; (3) rainfall reports for the previous 24 hours; (4) actual powerplant releases converted to daily discharge; (5) advance estimates of power demand converted to daily discharge; (6) advance estimates of uncontrolled runoff at Montague; and (7) average times for routing of water from the several sources. Variable errors of estimate occur in projecting data, but these data must be used in the daily design and direction of releases from the reservoirs.

The time of transit of water from Pepacton Reservoir to Montague was greater than that from any other reservoir above Montague, therefore, the time of daily directed releases to maintain prescribed rates of flow at Montague was based on time of transit from Pepacton Reservoir. Releases from Cannonsville and Neversink Reservoirs were timed to arrive at Montague concurrently with releases from Pepacton Reservoir. To allow for the actual differences in transit times, daily directed releases began at Pepacton at 1200 hours, at Cannonsville at 2400 hours, and at 1500 hours the following day at Neversink.

The determination of the amount of release required from the City's reservoirs to maintain specified rates of flow at Montague was based on estimates of releases from Lake Wallenpaupack and Rio Reservoir and an estimate of the uncontrolled runoff at Montague. Taking into account the time of transit from these sources to Montague, this determination required that advance estimates of the following components be made on the morning of each day: (1) the expected release of water from Lake Wallenpaupack for power production for a 24-hour period, beginning at 0800 two days later; (2) expected release of water from Rio Reservoir for power production for a 24-hour period, beginning at 1600 hours, two days later; and (3) expected uncontrolled runoff at Montague three days later. The River Master daily operation record for computing daily directed release from the City's reservoirs during the periods of low flow is shown in table 15.

The electric power companies cooperated fully in furnishing advance estimates of powerplant releases. As the hydroelectric plants were used chiefly for meeting peak-power demands of the system, advance estimates were subject to many modifying factors such as the influence of the vagaries of weather upon peak-power demand and unpredictable transmission and mechanical difficulties in electric-system operation. In addition, the power companies are members of wide area power pools which may present unforeseen demands for power generation. As a result, the actual use of water for power generation was at times at considerable variance with the advance estimates that were used by the River Master's office in design computation.

For computation purposes during periods of low flow, the estimate of uncontrolled runoff at Montague three days in advance was treated as two items: (1) present runoff and (2) estimated increase in runoff from precipitation. The present runoff was computed for 2,143 square miles (mi^2) of uncontrolled drainage area above Montague based on conditions over the drainage area as of 0800 hours on the morning the estimate was made. The estimated increase in runoff was computed from precipitation which was forecast to occur on the day the estimate was made and the following two days. Estimated quantities for these items are shown in table 15.

During the winter period, the advance estimate of the uncontrolled runoff (present conditions) was based on flows at nearby gaging stations and on the recession curve of the computed uncontrolled flow at Montague projected to the design date, three days hence.

During open-river conditions, the present runoff portion of the advance estimate of uncontrolled runoff was based on discharges as of 0800 hours at gaging stations listed below:

Station	Drainage area (mi^2)
Beaver Kill at Cooks Falls, N.Y.	241
Cadosia Creek at Cadosia, N.Y.	17.9
Oquaga Creek at Deposit, N.Y.	67.6
Equinunk Creek at Equinunk, Pa.	56.3
Callicoon Creek at Callicoon, N.Y.	110
Tenmile River at Tusten, N.Y.	45.6
Lackawaxen River at Hawley, Pa.	290
Shohola Creek near Shohola, Pa.	83.6
Neversink River at Port Jervis, N.Y.	336

The procedure for computing the advance estimate combined a routing and recession (as applicable) of the 0800 hour discharges of the Beaver Kill, Oquaga, Equinunk, Callicoon, and Shohola Creeks and Tenmile, Lackawaxen, and Neversink Rivers to Montague, with a computed yield from the remaining ungaged, uncontrolled drainage area. Releases from Neversink Reservoir were deducted from discharge of the Neversink River site. The yield from the ungaged, uncontrolled drainage area was estimated on the basis of the yield of Cadosia, Oquaga, Equinunk, and Callicoon Creeks, and Tenmile and Lackawaxen Rivers with applicable routing and recession of the individual gaging stations. The yield from the ungaged-uncontrolled area was adjusted periodically to account for differences between the forecasted uncontrolled runoff and the observed runoff at the Montague gaging station.

The advance estimate of increase in runoff from precipitation is shown in table 15 under the heading of "Weather Adjustment." The National Weather Service Office, Philadelphia, Pa., cooperated throughout the low-flow periods by furnishing quantitative forecasts of average precipitation over the drainage area above Montague and air temperatures for each day of the three-day design period. During the winter, the probable increase in runoff was estimated from the current state of snow and ice and from forecasted temperature and precipitation for the several days under consideration. During open-river conditions, runoff from the forecasted precipitation was estimated from previously established relationships.

The total anticipated flow at Montague, exclusive of releases from the City's reservoirs (table 15), was the sum of the forecasted releases from the power reservoirs, the estimated uncontrolled runoff under then current conditions, and the weather adjustment. The amount by which this computed flow was less than the prescribed Montague rate indicated the expected deficienty at Montague, which would have to be made up by corresponding releases from New York City reservoirs.

There were times when revised forecasts of weather or powerplant releases became available before the completion of the required releases from the reservoirs. At such times, the releases required from the reservoirs were recomputed on the basis of the revised information, and the release required was changed. Usually this procedure resulted in a reduced release requirement from New York City reservoirs for that day and therefore conserved water. Only the final figures are shown in table 15.

ANALYSIS OF FORECASTS

Forecasts of the flow at Montague based on the anticipated flow of the several components (exclusive of the release from the City's reservoirs) vary somewhat from observed flow on most days even under the most favorable conditions. Daily variations in the several components are often partially compensating with the resulting flows being fairly close to the estimate.

The advance estimate of flow of the Delaware River at Montague exclusive of the releases from the New York City reservoirs was less than the applicable rate on all but 11 days scattered throughout the period from May 24 to November 23, 1991. The table below compares the advance estimates of the various contributions to the flow at Montague to the observed operations during the May 24 to October 16 and October 25 to November 23, 1991 periods.

	Advance estimates [$(ft^3/s)\cdot d$]	Observed operations [$(ft^3/s)\cdot d$]
New York City releases		
Directed	[a] 156,125	[b] 156,309
Power releases		
Lake Wallenpaupack	24,663	26,694
Rio Reservoir	9,685	14,931
Runoff from uncontrolled area	[c] 98,199	[c] 105,185

[a] Directed release as designed.
[b] Actual release in response to direction.
[c] May 24 to October 16 and October 25 to November 22.

During the period of comparison, New York City released slightly more water, 0.12 percent, than was directed. The power companies released 8.2 percent more water from Lake Wallenpaupack and 54 percent more water from Rio Reservoir than was forecast. The total power releases were 21 percent more than the forecast. The observed runoff from the uncontrolled area during the period was 7.1 percent more than the forecasted runoff from the uncontrolled area. November 23 was removed from the comparison for the uncontrolled runoff because the flow was affected by a very high runoff event from precipitation that was much higher than was forecasted and would have greatly distorted the data (19.6 percent v. 7.1 percent).

On the basis of the observed discharges at Montague, exact forecasting of releases required from the City's reservoirs during the report year would have totaled 148,601 $(ft^3/s)\cdot d$. The directed releases totaled 156,309 $(ft^3/s)\cdot d$, or 5.2 percent more than for exact forecasting.

A comparison of the hydrographs of forecasted uncontrolled runoff and the actual uncontrolled runoff (fig. 3), indicate that the forecasting procedures tended to underestimate the runoff during high precipitation events but were generally adequate. The forecast included anticipated uncontrolled runoff under then-existing conditions plus the weather adjustment based on forecast precipitation. Adjustments to the forecast procedures were made when needed to compensate for errors in the design, but because of the delay between the release of water and the observation of the effect that the adjusted release had on the Montague flow, it takes several days for adjustments to become effective.

Analysis of the precipitation forecasts indicate that frequently when a precipitation event moves through the basin, the total precipitation forecasted for the three-day design period is fairly accurate but the storm may occur either earlier or later in the period. The accuracy of the runoff forecasts are significantly affected by the timing of the precipitation events. In addition, if the storm track is somewhat different than was anticipated, the amount and timing of the runoff is significantly affected.

DIVERSIONS TO NEW YORK CITY WATER SUPPLY

The 1954 Amended Decree allows New York City to divert water from the Delaware River basin at a rate not to exceed 800 Mgal/d. The Decree also specifies that the rate of diversions will be computed as the aggregate total diversion beginning on June 1 of each year divided by the number of days elapsed since the previous May 31.

Table 14 shows diversions from Pepacton, Cannonsville, and Neversink Reservoirs to the New York City water-supply system (Rondout Reservoir) during the report year. The tabulation includes a running account of the average rates of the combined diversions from the reservoirs, computed as prescribed by the Decree or the "Interstate Water Management Recommendations of the Parties to the Decree." The tabulation below shows the allowable maximum diversion rates and the actual diversions during those periods.

Effective dates	Allowable diversions (Mgal/d)	Actual diversions (Mgal/d)
June 1, 1990 to May 31, 1991	800	747
June 1 to Sept. 12, 1991	800	797
Sept. 13 to Oct. 10, 1991	680	663
Oct. 11 to Nov. 30, 1991	560	549

During the year, a total of 262.087 Bgal of water was diverted to the New York City water supply system. The allowable diversion during the year was 282.674 Bgal.

STORAGE IN NEW YORK CITY RESERVOIRS

The New York City Board of Water Supply determined the "point of maximum depletion" and other pertinent reservoir levels and contents of Pepacton, Cannonsville, and Neversink Reservoirs as follows:

{Elev. is distance above sea level}

Level	Pepacton Reservoir		Cannonsville Reservoir		Neversink Reservoir	
	Elevation (ft.)	Contents (Bgal)	Elevation (ft.)	Contents (Bgal)	Elevation (ft.)	Contents (Bgal)
Full pool or spillway crest	1,280.00	*140.190	1,150.00	*95.706	1,440.00	*34.941
Point of maximum depletion	1,152.00	*3.511	1,040.00	*1.020	1,319.00	*0.525
Sill of diversion tunnel	1,143.00	*4.200	+1,035.00	*1.564	1,314.00	
Sill of river outlet tunnel	1,126.50		1,020.5		1,314.00	
Dead storage		1.800		0.328		1.680

*Contents shown are quantities stored between listed elevations.
+Elevation of mouth of inlet channel of diversion works.

Tables 10, 11, and 12 show storage in Pepacton, Cannonsville, and Neversink Reservoirs, respectively, above the "point of maximum depletion" or minimum full-operating level.

On December 1, 1990 combined storage in the three reservoirs was 223.341 Bgal. Storage increased steadily until early January, decreased somewhat throughout January, then increased gradually the rest of the winter and spring reaching the maximum storage for the year on May 10, 1991 (fig. 2).

The seasonal decline in storage began in mid-May and continued until late November in response to the diversions to the New York City water-supply system and the releases required to maintain the Montague flow objective. The rate of decline was greater than normal because of below-normal precipitation and above normal releases to meet the Montague flow objective. The rate of decline in storage decreased in mid-September in response to slightly improved precipitation and significantly reduced diversions and releases when the reduced targets were put into effect on September 13, 1991, as discussed earlier. Precipitation averaging slightly more than three inches over the upper basin occurred during the November 21-25 period. The resulting runoff helped to increase storage from a seasonal low of 80.682 Bgal on November 21 to 107.766 Bgal on November 30, 1991 (fig. 2). However, the storage remained in the drought warning zone of the operation curves at the end of the report year.

COMPARISONS OF RIVER MASTER OPERATION DATA AND OTHER STREAMFLOW RECORDS

It has been explained that the River Master operations are, in effect, day-to-day operations, for which it is necessary to use preliminary records of streamflow. The following summaries show comparison of records used in the River Master operations and U.S. Geological Survey records. In the comparison of releases, the data used were reported in units of Mgal/d and con verted to ft^3/s in the summaries.

Releases from New York City Reservoirs

The River Master operations data on the controlled releases from Pepacton, Cannonsville, and Neversink Reservoirs, to the Delaware River were obtained from calibrated instruments connected to venturi meters installed in the outlet conduits.

The Geological Survey gaging station on the East Branch Delaware River at Downsville, N.Y., is 0.5 mile downstream from Pepacton Reservoir dam (fig. 1). The discharge shown in table 4 includes releases and spillage from Pepacton Reservoir. It also includes a small amount of seepage, which enters the channel between the dam and the gage site, and a small amount of runoff, which originates between the dam and the gage site. The drainage area at the dam is 371 mi^2 and at the gaging station is 372 mi^2.

The table below lists the comparison of the releases from Pepacton Reservoir reported by New York City to the gaging station records shown in table 4.

Approximate rate of flow reported by NYC (ft^3/s)	6	19	50	70	100	130	340	730
Percent difference from gaging-station record a/	-22.5	-2.1	-13.3	+4.7	+7.3	+16.2	+14.9	+2.0

a/ (-) indicates reported release was lower than gaging station record

The differences are similar to the differences observed in previous years. However, the range in the releases was larger in 1991 than in most years. The comparison indicates that the meters tend to under register the flows at the low end of their range and to over register at the high end of the range. We are working with New York City to make adjustments to the meters periodically to insure that in the future the meter readings will be more accurate.

The Geological Survey gaging station on the West Branch Delaware River at Stilesville, N.Y. is 1.4 miles downstream from Cannonsville Dam (fig. 1). The discharge shown in table 5 includes releases and spillage from Cannonsville Reservoir and the runoff from 2 mi^2 of drainage area between the dam and the gage site. The drainage area at the dam is 454 mi^2, and that at the gaging station is 456 mi^2.

The following table compares the releases from Cannonsville Reservoir reported by New York City to the gaging station records shown in table 5.

Approximate rate of flow reported by NYC (ft^3/s)	23	33	270	400	520	980	1070	1230
Percent difference from gaging-station record a/	-17.0	-20.7	-1.1	+12.1	+9.9	+4.0	+1.7	+1.4

a/ (-) indicates reported release was lower than gaging station record

The gaging-station records are considered good above 300 ft^3/s and poor below. The agreement between the data reported by New York City and the gaging station records is also good at high flows, but is not very good at low flows. The gaging-station records include the run-off from precipitation on the area between the dam and the gaging station and includes seepage that occurs near the base of the dam. On January 29, 1992, the seepage was measured and found to be 2.4 ft^3/s. This value agrees with estimates made in previous years. If the gaging-station record is adjusted for seepage, the agreement at 23 ft^3/s and 33 ft^3/s from the above table becomes -10.0 percent and -16.4 percent respectively. We are continuing to monitor the differences and are working with New York City to improve the agreement.

The Geological Survey gaging station on the Neversink River at Neversink, N.Y. is 1,650 feet downstream from Neversink Dam (fig. 1). The discharge shown in table 7 includes releases from Neversink Reservoir and, during storms, a small amount of runoff which originates between the dam and the gage site. The drainage area at the dam is 92.5 mi^2 and that at the gaging station is 92.6 mi^2.

For releases from Neversink Reservoir of approximately 6.0, 14, 24, 45, 69, and 86 ft^3/s at the Geological Survey gaging station, the venturi meter instrument indicated -7.3, +13.6, +6.8, +1.1, +2.0 and +6.4 percent difference, respectively, in rates of release from the reservoir compared to the gaging-station records.

The above comparisons indicate very good agreement between the data from the venturi meters and U.S. Geological Survey gaging stations at Neversink Reservoir, for high flows at Cannonsville Reservoir and for mid-range and high flows at Pepacton Reservoir. The gaging-station records are considered poor at the Stilesville gage for flows below 300 ft^3/s. Therefore, the venturi instruments are considered to provide more accurate records at the very low-flow rates. Additional studies will be done during 1992 to determine why the records do not agree at other levels for Cannonsville and Pepacton Reservoirs.

Releases from Lake Wallenpaupack

For the River Master operations, December 1 to November 30, records of daily discharge through the Wallenpaupack powerplant were furnished by the Pennsylvania Power & Light Company (see table 16). Daily discharges were computed on an 0800 hour to 0800 hour time basis to allow for the 16-hour average transit time to Montague.

The records of daily mean discharges for Wallenpaupack Creek at Wilsonville, Pa., published by the U.S. Geological Survey, were also furnished by the Company. These discharges, shown in table 6, represent the flow through the turbines of the powerplant and are computed on a midnight-to-midnight basis.

During December 1990 through November 1991, the River Master's record based on computations by Pennsylvania Power & Light Company, agrees with the U.S. Geological Survey record except for a slight variation due to the difference in the time frame and rounding of the computations.

Delaware River at Montague, N.J.

The River Master's operation record shown in table 16 indicated 0.2 percent more discharge for the year than the U.S. Geological Survey record (table 8), and daily records were in good agreement.

Diversion Tunnels

Records of diversions through the East Delaware, West Delaware, and Neversink Tunnels (fig. 1) were furnished to the River Master's Office by the City of New York. These records were obtained from New York City's calibrated instruments connected to venturi meters installed in the tunnel conduits. These instruments include a differential pressure transmitter which is connected to a numerical totalizer that records the volume of water discharged and a rate-of-flow indicator that records on a Bristol-type chart. The totalizer readings are transmitted electronically to the New York City Bureau of Water Supply and are reported to the River Master office daily. Current-meter measurements were made by the River Master's office to verify the accuracy of the reported diversions. The measurements were made in the outlet channels downstream from the tunnels.

Conditions in the outlet channel of the East Delaware Tunnel were unfavorable for the measurement of flows for much of the year due to high water levels in Rondout Reservoir. The results of one current-meter measurement made during the year showed that the venturi-meter instruments gave higher figures by 1.7 percent for the totalizer and 1.3 percent for the digital indicator needle.

Comparison of the data provided by New York City with discharges obtained from recorded gage-heights and the rating curve for the weir on the outlet channel indicate that the data provided by New York City were within acceptable limits.

The powerplant that used water diverted through the East Delaware tunnel operated most days of the year. When the powerplant was not in operation, there was a small amount of leakage through the wicket gates which was not recorded on the totalizer. Results of a current-meter measurement March 28, 1989 indicated a flow rate of 12.3 ft^3/s from cooling water and leakage. This measurement agrees with measurements made in previous years and indicates that the leakage has not changed substantially with time.

Since the powerplant was operated continuously except for a portion of the time on 58 days during the year, the unmeasured leakage was approximately 156 Mgal.

Based upon the measurement obtained this year and in previous years, the record of the quantity of water diverted through the East Delaware Tunnel was substantially correct.

The West Delaware Tunnel is used to divert water from Cannonsville Reservoir into Rondout Reservoir. One current-meter measurement of flow in the West Delaware Tunnel made during the year indicated that the venturi instruments gave higher results by 4.9 percent for the totalizer, and 5.2 percent for the rate-of-flow indicator. Inspections of the channel downstream from the outlet, when valves were closed, showed negligible leakage.

A powerplant, which uses water diverted through the West Delaware Tunnel, operates only when diversions are less than 300 Mgal/d. When the powerplant is not operating, the valves on the pipelines to the powerplant are closed, and there is no leakage through the system.

The results of the measurement and inspections made this year and during past years indicate that the reported record of the quantity of water diverted through the West Delaware Tunnel was substantially correct.

The Neversink Tunnel is used to divert water from Neversink Reservoir into Rondout Reservoir. Two measurements of flows from the Neversink Tunnel were made during the year, however, one measurement was made during changing flow conditions and is not considered a representative measure of the accuracy of the venturi instruments. The results of comparative data from venturi and two current-meter measurements, one measurement made this year and one measurement made after the end of the year, showed that on average, the venturi instruments were higher by 2.8 percent for the totalizer and 3.2 percent for the rate-of-flow indicator.

When the powerplant that used water diverted through the Neversink Tunnel was not in operation, a small amount of leakage occurred that was not recorded on the venturi instruments. Based on measurements made during the previous years, the average rate of leakage is 14.0 ft^3/s (9.0 Mgal/d). When the powerplant was operating, the leakage was included in the recorded flow. Based on the above rate and on records of power plant operation, approximately 1.5 Bgal of water was diverted but unrecorded.

DIVERSIONS BY NEW JERSEY

The Amended Decree allows New Jersey to divert water from the Delaware River or its tributaries in New Jersey, outside the Delaware River Basin without compensating releases. These diversions may not exceed 100 Mgal/d (154.7 ft^3/s) as a monthly average, with the diversion on any day not to exceed 120 Mgal/d (185.6 ft^3/s). Beginning with this report, the U.S. Geological Survey gaging station, Delaware and Raritan Canal at Port Mercer, New Jersey (fig. 1) will be used as the official location for measuring the diversions by New Jersey (table 13).

The following table lists the allowable diversions by New Jersey, the periods that they were in effect, and the maximum diversion during each period for the report year.

Effective dates	Allowable Diversion Mgal/d	Maximum 30-day average diversion (Mgal/d)
Dec. 1, 1990 to Sept. 12, 1991	100	98.6
Sept. 13 to Oct. 10, 1991	85	83.8*
Oct. 11 to Nov. 30, 1991	70	69.9

* average for period since it is less than 30 days

The 30-day average diversion was computed weekly throughout the year to monitor compliance with the terms of the Decree and with the reduced diversions allowed during the period of drought warning. The maximum 30-day average diversion was 98.6 Mgal/d during the 30-day period ending August 18, 1991. The maximum daily diversion was 105 Mgal on July 29, 1991. These computations show that the diversions by New Jersey did not exceed the limits allowed by the Decree.

CONFORMANCE OF OPERATIONS AS PROVIDED UNDER AMENDED DECREE OF THE U.S. SUPREME COURT, DATED JUNE 7, 1954

Operations were conducted as prescribed by the Decree December 1, 1990 to July 20, 1991. Effective July 21, 1991, the Parties to the Decree unanimously agreed to suspend the release of the excess-release quantity prescribed in the Decree in an effort to combat the impending drought conditions in the basin. On September 8, 1991, hydrologic conditions in the basin entered the drought-warning zone of the operation curves and operations were conducted as prescribed in the "Interstate Water Management Recommendations of the Parties to the Decree" until October 10, 1991. From October 11 to November 30, 1991, operations were conducted as prescribed in several unanimous agreements by the Parties to the Decree which were designed to alleviate the drought conditions in the basin.

Diversions from the Delaware River Basin to the New York City water-supply system were less than those authorized by the Decree, the Interstate Water Management Recommendations of the Parties to the Decree and the agreements among the Parties to the Decree.

Under Compensating Releases of the Montague Formula, New York City released water from its reservoirs at rates designed by the River Master to maintain the applicable Montague flow objectives and complied fully with the directives of the River Master during the year.

Diversions from the Delaware River basin by New Jersey were within the limits prescribed by the Decree, et al. New Jersey also complied fully with the requests of the River Master.

Table 4. - Daily Mean discharge, in cubic feet per second, of East Branch Delaware River at Downsville, N.Y. (01417000) for the year ending November 30, 1991. Preliminary U.S. Geological Survey record.

DAY	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
1	59	57	58	58	64	160	69	102	74	328	324	236
2	59	58	57	58	67	257	69	78	97	328	322	274
3	58	57	58	58	67	252	69	65	110	411	494	312
4	59	56	57	58	67	215	69	78	109	492	680	493
5	59	56	56	58	67	176	69	90	96	492	490	660
6	59	56	55	57	67	182	67	87	74	604	184	656
7	59	56	56	57	67	282	68	100	63	721	64	655
8	59	56	57	57	67	251	69	100	64	717	65	632
9	59	57	56	56	67	260	81	76	63	717	235	577
10	59	56	56	56	67	310	93	65	63	717	173	461
11	59	56	56	56	67	275	91	74	63	715	65	466
12	59	56	56	56	67	187	79	84	63	714	79	395
13	59	56	56	56	67	134	65	85	63	712	238	265
14	59	56	56	56	67	94	66	85	74	511	210	260
15	59	56	56	56	68	74	79	84	85	320	19	247
16	59	56	56	56	68	67	93	84	84	294	19	260
17	59	56	54	56	68	67	93	98	84	247	19	168
18	59	56	54	56	68	69	93	112	84	223	19	99
19	59	56	57	56	68	68	93	111	84	315	19	88
20	59	56	57	56	68	67	93	111	74	495	19	69
21	59	56	58	56	69	67	91	111	73	356	19	38
22	59	56	57	56	69	67	91	99	136	170	66	8.4
23	59	55	58	56	69	67	91	80	239	124	166	8.5
24	60	56	57	57	69	82	79	64	269	42	410	8.0
25	60	56	58	57	69	95	67	63	268	68	469	7.9
26	60	53	58	57	69	96	80	63	267	397	149	7.8
27	59	52	58	57	69	96	99	63	268	688	127	7.8
28	58	54	58	57	70	94	116	63	266	556	138	7.8
29	58	56		57	70	94	119	63	298	450	171	7.8
30	59	57		57	79	94	119	64	330	396	159	7.9
31	59	58		57		81		63	328		161	
Total	1829	1734	1586	1757	2045	4380	2520	2565	4313	13320	5772	7382.9
Mean	59.0	55.9	56.6	56.7	68.2	141	84.0	82.7	139	444	186	246

Year total 49,203 (ft^3/s)·d Mean 135 ft^3/s

Table 5. - Daily mean discharge, in cubic feet per second, of West Branch Delaware River at Stilesville, N.Y. (01425000) for the year ending November 30, 1991. Preliminary U.S. Geological Survey record.

DAY	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
1	42	2150	358	781	1360	751	335	1140	1250	963	37	275
2	42	1920	381	721	1310	633	335	1350	1210	989	37	259
3	43	1680	406	950	1240	505	335	1280	1220	995	37	260
4	54	1430	435	1640	1170	391	401	1320	1240	869	630	261
5	50	1180	414	2530	1100	302	269	1250	1180	856	629	311
6	47	999	428	2550	1050	254	273	1100	1290	933	112	338
7	46	884	693	2450	1040	332	586	954	1120	723	281	335
8	45	819	1260	2170	1020	352	704	907	1310	477	293	267
9	45	745	1570	1760	1130	323	609	1090	1100	471	221	259
10	44	726	1650	1440	1400	307	670	1370	981	457	83	259
11	44	682	1560	1220	1460	329	855	1410	293	472	967	260
12	44	628	1360	1130	1410	293	878	1390	291	498	548	259
13	44	605	1180	1060	1320	258	974	1380	289	713	73	259
14	44	541	1150	976	1230	260	877	1190	790	701	36	259
15	45	514	1040	941	1140	249	843	1420	636	290	27	259
16	46	551	845	870	942	214	664	1300	1200	274	27	90
17	46	812	626	819	766	175	821	1060	1120	272	27	37
18	52	975	513	820	602	159	791	1030	963	275	27	207
19	79	933	487	856	477	117	820	1340	547	276	27	259
20	348	878	943	883	394	75	1030	1240	473	272	27	257
21	570	840	1310	861	389	53	1030	552	250	274	27	90
22	935	730	1270	835	932	214	1090	507	60	96	27	36
23	1190	592	1250	883	1510	329	954	518	234	49	35	47
24	1800	568	1160	1000	1640	305	953	413	419	46	40	34
25	2290	545	1070	1190	1820	335	986	727	571	41	232	32
26	2150	485	923	1270	1750	358	900	1210	672	45	104	31
27	1820	468	884	1340	1520	571	1110	964	762	230	50	31
28	1560	455	835	1520	1310	458	1210	666	804	301	35	31
29	1350	367		1550	1090	396	1050	643	957	89	35	32
30	1450	315		1510	911	376	962	1190	949	38	34	32
31	2130	324		1440		392		1260	952		203	
Total	18495	25341	26001	39966	34433	10066	23315	33171	25133	12985	4968	5366
Mean	597	817	929	1289	1148	325	777	1070	811	433	160	179

Year total 259,240 (ft^3/s)·d

Mean 710 ft^3/s

Table 6. - Daily mean discharge, in cubic feet per second, at Wallenpaupack Creek at Wilsonville, Pa. (01432000) for the year ending November 30, 1991. Record furnished by Pennsylvania Power & Light Company.

DAY	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
1	226	468	467	828	226	0	0	126	43	0	648	0
2	0	946	230	0	227	0	0	0	0	0	751	0
3	992	928	0	0	0	0	0	0	0	53	832	0
4	1586	1040	0	747	230	0	0	0	0	0	802	0
5	1327	906	226	690	228	469	0	0	0	0	0	0
6	869	450	222	701	0	1400	0	0	0	0	0	0
7	976	944	223	724	0	0	0	0	0	0	826	131
8	0	968	223	710	228	0	0	46	230	0	837	45
9	0	938	0	0	483	0	0	0	0	173	964	0
10	815	427	0	0	0	0	0	0	0	225	851	0
11	933	942	806	692	0	0	0	0	0	219	829	0
12	959	456	960	698	305	0	0	0	574	224	0	0
13	932	462	944	698	0	525	0	0	584	229	0	0
14	928	920	946	659	0	0	0	0	770	0	283	0
15	220	922	949	702	224	0	0	234	411	0	0	0
16	282	944	951	0	221	0	0	0	574	967	290	0
17	862	932	341	0	192	0	0	0	0	873	788	0
18	926	927	925	698	224	0	0	224	0	803	948	0
19	945	468	943	955	228	0	0	506	60	828	712	0
20	936	441	820	943	0	0	0	0	0	808	716	0
21	841	1080	937	927	0	0	0	0	0	0	130	0
22	468	1070	928	950	0	0	0	471	0	0	0	0
23	465	1230	457	460	0	0	0	474	0	811	0	0
24	906	943	459	474	0	0	0	449	0	816	0	0
25	458	939	933	887	0	0	0	424	0	823	0	0
26	940	460	867	932	0	0	0	475	0	802	0	0
27	467	472	945	701	0	0	0	0	0	813	0	0
28	939	940	926	692	0	253	0	218	0	0	0	0
29	468	968		0	0	0	0	460	0	0	0	0
30	453	937		0	0	552	0	457	0	625	0	0
31	943	947		0		263		30	0		0	
Total	22062	25415	16628	16468	3016	3462	0	4594	3246	10092	11207	176
Mean	712	820	594	531	101	112	0	148	105	336	362	5.87

Year total 116,366 (ft^3/s)·d

Mean 319 ft^3/s

Table 7. - Daily mean discharge, in cubic feet per second, of Neversink River at Neversink, N.Y. (01436000) for the year ending November 30, 1991. Preliminary U.S. Geological Survey record.

DAY	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
1	26	24	23	23	36	47	45	76	52	42	44	36
2	26	24	23	23	43	46	45	58	74	42	43	23
3	26	24	23	23	44	46	45	45	85	42	44	22
4	26	24	23	24	44	47	45	53	85	41	44	22
5	25	24	23	23	46	48	45	69	77	43	44	22
6	26	24	23	23	46	47	45	70	57	46	43	22
7	26	24	23	23	45	46	44	74	44	55	43	22
8	26	24	23	22	45	46	44	73	44	68	43	22
9	26	24	23	23	46	46	53	54	44	67	43	22
10	25	24	23	23	46	46	68	43	43	58	43	22
11	26	24	23	23	45	46	68	52	43	43	44	22
12	27	24	23	23	47	47	59	68	59	43	43	21
13	26	23	23	24	48	46	42	68	86	43	43	21
14	26	24	23	24	45	47	43	68	71	43	43	22
15	27	24	24	23	45	47	52	68	52	43	33	22
16	26	24	24	23	44	48	68	68	65	42	14	22
17	26	23	24	23	45	48	68	68	64	56	14	22
18	26	23	24	24	45	48	68	74	64	81	14	22
19	24	23	24	23	45	48	70	86	65	60	14	22
20	24	23	25	23	46	47	69	86	53	42	14	22
21	25	22	23	24	46	46	70	85	42	42	14	22
22	24	22	23	24	46	46	70	86	42	43	14	15
23	25	21	23	24	46	46	70	80	42	45	25	6.4
24	24	22	23	24	46	55	61	67	42	35	43	6.1
25	25	23	23	23	46	70	45	59	42	20	43	6.0
26	25	23	23	23	46	70	54	45	41	24	42	6.0
27	25	23	23	24	46	70	75	45	51	43	42	6.1
28	24	23	23	23	46	69	87	45	67	43	43	6.1
29	24	23		23	46	68	85	45	67	42	43	5.9
30	24	23		23	47	68	82	44	57	43	42	5.8
31	23	23		23		56		44	42		42	
Total	784	723	651	721	1357	1601	1785	1966	1762	1380	1103	538.4
Mean	25.3	23.3	23.2	23.3	45.2	51.6	59.5	63.4	56.8	46.0	35.6	17.9

Year total 14,371.4 (ft^3/s)·d

Mean 39.4 ft^3/s

Table 8. - Daily mean discharge, in cubic feet per second, of the Delaware River at Montague, N.J. (01438500) for the year ending November 30, 1991. Preliminary U.S. Geological Survey record.

DAY	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
1	3710	17300	5170	5420	6780	5420	3820	1680	1750	1640	1740	1040
2	2820	13500	4310	5240	6820	5260	2570	1680	1770	1560	1680	982
3	2810	11400	3660	6810	6440	5200	2240	1940	1660	1600	1650	1010
4	14600	10100	3830	15700	6050	4620	2060	1920	1710	1640	1670	1070
5	26300	8640	4250	21200	5660	3980	1820	1840	1780	1770	1620	1090
6	15500	7510	4930	15500	5010	4860	1790	1900	1780	1720	1530	1120
7	11500	7110	7760	13400	4780	6620	1600	1840	1790	1690	1780	1410
8	9240	6420	15000	13000	4990	6660	1370	1800	1770	1780	2010	1590
9	7280	5910	12200	10400	4650	5710	1580	1750	1810	1710	1730	1510
10	6820	5480	10400	8600	5330	5120	1760	1510	1850	1840	1730	1390
11	6640	5410	9220	7740	4930	4780	1980	1570	1810	1730	1700	1390
12	5850	4890	8610	7280	4990	4390	1890	1810	1670	1680	1860	1580
13	5440	4610	7410	6460	4630	4240	2130	1740	1700	1700	1590	1610
14	5340	5130	7500	6260	4210	4530	2100	1920	1570	1680	1430	1730
15	4630	4940	7790	6170	4560	3780	2010	1970	1880	1650	1420	1350
16	3960	5230	7210	5600	5120	3320	2070	2080	2000	1770	1960	1350
17	4660	7010	5790	4930	4600	3190	1860	2110	2180	2220	2170	1270
18	5540	8870	5080	5480	4220	2680	1720	1900	1780	1920	3770	1270
19	10000	7350	5450	7680	3750	2370	1810	2020	2100	2160	3160	1060
20	10700	6050	6050	8080	3440	2220	1740	2200	1960	2270	2630	1030
21	9100	6600	9940	7580	3760	2060	1850	1840	1490	2390	2400	1160
22	9660	6240	9210	6740	9870	2100	2000	1930	1670	1480	1540	1910
23	10100	5370	8600	6850	11800	1850	1910	1970	2400	1380	1310	13400
24	13800	4840	7040	8380	10300	1740	1870	1950	1490	1970	1290	17400
25	17200	5200	7050	9890	9840	1820	1690	1900	1060	1980	1130	10500
26	13700	4400	6740	10200	8930	1700	1670	1650	1360	2130	1090	7630
27	11100	3700	6340	8860	7460	1720	1690	1790	1640	1750	1490	5830
28	9500	4100	5890	9020	6550	2240	1680	1810	1750	1600	1380	4480
29	9320	4720		8890	6060	2630	2050	1670	1820	1240	1180	3830
30	8200	4690		8130	5600	2190	1810	1650	1810	1450	1110	3450
31	17100	5140		7500		3330		1620	1770		1030	
Total	292120	207860	202430	272990	181130	112330	58140	56960	54580	53100	53780	95442
Mean	9423	6705	7230	8806	6038	3624	1938	1837	1761	1770	1735	3181

Year total 1,640,862 (ft^3/s)·d

Mean 4,496 ft^3/s

Table 9. - Daily mean discharge, in cubic feet per second, of Delaware River at Trenton, N.J. (01463500) for the year ending November 30, 1991. Preliminary U.S. Geological Survey record.

DAY	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
1	8070	32500	11900	11200	14900	12700	5540	3500	2900	2890	2610	2670
2	7650	30100	11200	10500	13700	11800	6760	3270	2720	2830	2760	2670
3	7180	25000	9900	11100	13100	11500	5720	3270	2780	2630	3020	2790
4	23100	21600	9390	18600	12800	10900	4790	3770	2690	2650	3030	2730
5	53800	19300	9250	36400	11900	9930	4630	3510	2610	2840	2990	2390
6	47700	17100	9940	36100	11400	10800	4370	3720	2560	3040	2940	2450
7	34000	15800	12700	31200	10800	14700	4100	3510	2600	3060	3240	2410
8	25400	14400	18100	27000	10100	15200	3900	4120	2600	2920	3140	2390
9	20300	14000	24700	24100	9750	13300	3670	3620	3240	2840	3200	2540
10	17100	14000	21300	20100	9790	12400	3610	3290	4110	2850	3350	2810
11	15700	13300	18700	17300	9670	11200	3630	3140	4250	2840	3070	2840
12	14700	16700	16700	15600	9140	10100	3960	2880	3390	2950	3170	2900
13	13500	14200	15200	14800	8920	9540	4110	3400	3050	2750	3460	2960
14	12600	12100	14300	13700	9240	9100	4050	3780	2850	2610	3590	3010
15	11800	10900	15400	13800	8730	10000	4010	3400	2810	2670	3230	3010
16	12500	13200	14800	14100	9140	9130	3950	3300	2710	2680	3480	3140
17	11800	21600	13200	13500	10000	8080	3850	3270	2980	2630	4240	2800
18	12200	21000	12200	12800	10400	7560	4150	3200	3220	2800	6840	2710
19	14600	20500	10800	15500	9580	7120	4080	3200	3600	3390	7510	2640
20	18200	17100	11900	16700	8740	6230	4480	3210	4530	3740	7060	2580
21	19000	15700	12900	16700	10400	5880	4650	3420	5420	3720	5880	2460
22	19400	15600	16400	15500	16600	5530	3960	3410	4050	3570	5160	2710
23	19800	13800	15900	14700	21900	5230	3930	3110	3130	3510	4590	10300
24	26500	12400	14500	16700	22900	5070	4660	3660	2940	2720	3680	26800
25	36200	12000	13100	17800	23000	4660	4430	3620	3710	4220	3230	25000
26	33900	10700	12500	19100	20900	4610	3920	3760	3100	6640	3130	17100
27	27800	10100	12400	19500	18400	4640	3480	4400	2580	4850	2860	13500
28	23800	9510	11600	18400	15800	5050	3380	3340	2540	4010	2700	11400
29	20800	9570		17300	14200	5100	3270	3370	2920	3380	2910	9740
30	20400	10300		17200	13200	4990	3150	3240	2950	3030	2970	8370
31	24700	11500		16100		5060		3130	2980		2800	
Total	654200	495580	390880	563100	389100	267110	126190	106820	98520	97260	115840	181820
Mean	21100	15990	13960	18160	12970	8616	4206	3446	3178	3242	3737	6061

Year total 3,486,420 (ft^3/s)·d

Mean 9,552 ft^3/s

Table 10. - Storage in Pepacton Reservoir, N.Y. for year ending November 30, 1991
(Storage in millions of gallons above elevation 1,152.00 ft. Add 7,711 million gallons for total contents above sill of outlet tunnel, elevation 1,126.50 ft.) Storage at spillway level is 140,190 million gallons.
(River Master daily operations record; gage reading at 0800)

Day	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov
1	106,900	120,838	119,444	121,402	131,327	140,468	135,837	123,342	108,862	94,066	73,940	62,136
2	106,868	121,505	119,325	121,402	131,558	140,560	135,439	122,739	108,411	93,393	73,393	61,663
3	106,612	122,053	119,138	121,848	131,898	140,598	135,040	122,275	108,056	92,754	72,821	61,143
4	107,284	122,498	119,019	122,619	132,182	140,671	134,678	121,797	107,476	91,997	72,227	60,533
5	108,588	122,705	118,917	124,100	132,237	140,709	134,534	121,505	106,996	91,364	71,519	59,797
6	109,348	122,877	118,799	124,932	132,505	140,541	134,210	121,043	106,532	90,569	71,007	59,043
7	110,046	123,084	118,765	125,748	132,558	140,894	133,689	120,582	106,068	89,650	70,613	58,225
8	110,306	122,912	119,682	126,289	132,594	140,894	133,365	120,089	105,653	88,778	70,269	57,492
9	110,371	122,842	120,225	126,691	132,988	140,913	132,970	119,614	105,098	87,912	70,028	56,682
10	110,794	122,825	120,548	127,058	133,455	140,950	132,558	119,070	104,811	87,023	69,448	55,957
11	110,582	122,636	120,787	127,128	133,545	140,727	132,147	118,545	104,463	86,322	68,996	55,337
12	110,518	122,550	120,941	127,250	134,066	140,597	131,826	118,056	104,066	85,229	68,656	54,831
13	110,663	122,481	120,992	127,076	134,102	140,468	131,523	117,669	103,578	84,187	68,320	54,328
14	111,219	122,070	120,992	126,989	134,318	140,468	131,131	117,232	103,105	83,318	67,772	53,826
15	111,138	122,104	121,146	127,023	134,426	140,449	130,812	116,780	102,585	82,635	67,299	53,414
16	111,105	121,831	121,180	126,988	134,660	140,338	130,422	116,394	102,258	82,065	67,299	53,016
17	111,040	121,660	121,043	126,918	134,859	140,153	129,996	115,825	102,101	81,553	67,299	52,508
18	110,990	121,865	121,026	126,936	134,660	140,116	129,571	115,243	101,633	81,044	67,077	52,113
19	111,447	121,711	120,753	127,076	134,931	139,951	129,218	114,862	101,258	80,630	67,077	51,817
20	111,922	121,591	120,804	127,337	134,805	139,748	128,743	114,329	100,962	80,165	66,954	51,521
21	112,053	121,334	121,385	127,390	134,968	139,509	128,304	113,848	100,528	79,455	66,645	51,127
22	112,761	121,351	121,626	127,530	135,801	139,234	127,811	113,404	100,218	78,843	66,522	51,019
23	113,090	121,026	121,660	127,794	136,981	138,903	127,320	112,991	99,706	78,329	66,289	54,238
24	114,246	120,872	121,643	128,040	137,565	138,737	126,866	112,530	99,029	77,950	65,861	57,355
25	115,525	120,787	121,728	128,409	137,966	138,498	126,394	112,119	98,506	77,534	65,299	58,789
26	116,528	120,429	121,711	128,761	138,535	138,076	125,975	111,644	97,892	77,575	64,752	59,658
27	117,031	120,293	121,540	128,972	138,976	137,730	125,522	111,301	97,267	76,917	64,401	60,194
28	117,501	120,072	121,488	129,713	139,730	137,547	124,742	110,794	96,734	76,051	63,978	60,428
29	117,736	119,902		130,138	139,656	137,145	124,274	110,485	96,098	75,308	63,545	60,639
30	118,175	119,478		130,635	140,227	136,890	123,807	109,835	95,554	74,583	63,066	60,850
31	119,716	119,665		131,060		136,217		109,316	94,830		62,671	
Change	+12,528	-51	+1,823	+9,572	+9,167	-4,010	-12,410	-14,491	-14,486	-20,247	-11,912	-1,821
Equiv. Mgal/d	+404.1	-1.65	+65.1	+308.8	+305.6	-129.4	-413.7	-467.5	-467.3	-674.9	-384.3	-60.7
Equiv.ft^3/s	+625	-2.55	+101	+478	+473	-200	-640	-723	-723	-1,044	-594	-93.9

Change for year -46,338 Mgal — Equiv. for year -127.0 Mgal/d — Equiv. for year -196.4 ft^3/s

Table 11. - Storage in Cannonsville Reservoir, N.Y. for year ending November 30, 1991
(Storage in millions of gallons above elevation 1,040.00 ft. Add 2,584 million gallons for total contents above sill of outlet tunnel, elevation 1,020.50 ft.) Storage at spillway level is 95,706 million gallons.
(River Master daily operations record; gage reading at 0800)

Day	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov
1	87,349	98,587	96,414	97,138	97,814	97,267	91,553	73,848	48,592	30,738	24,609	25,579
2	87,378	98,490	96,494	96,977	97,685	96,977	91,325	72,947	47,703	30,071	24,583	25,519
3	87,392	98,184	96,494	97,218	97,621	96,864	91,112	72,033	46,713	29,478	24,609	25,477
4	87,826	98,007	96,607	97,814	97,557	96,269	90,731	71,013	45,812	28,866	24,609	25,375
5	89,636	97,637	96,607	98,828	97,444	96,462	90,427	70,046	44,856	28,345	24,202	25,290
6	90,716	97,460	96,511	98,925	97,428	96,205	90,214	69,119	43,988	27,843	23,761	25,128
7	91,675	97,299	96,816	98,861	97,396	96,446	89,880	68,324	42,962	27,272	23,753	25,009
8	92,283	97,202	97,476	98,603	97,412	96,494	89,317	67,649	42,142	26,915	23,753	24,864
9	92,710	97,009	97,718	98,039	97,492	96,414	88,754	66,936	41,070	26,566	23,482	24,779
10	93,181	96,929	97,991	97,830	97,911	96,269	88,252	66,095	40,293	26,336	23,281	24,668
11	93,440	96,977	98,039	97,524	97,878	96,253	87,666	65,319	39,800	26,030	22,979	24,575
12	93,577	96,961	97,782	97,379	97,830	96,237	87,262	64,083	39,432	25,690	22,523	24,583
13	93,835	96,864	97,524	97,331	97,766	96,253	86,828	63,065	39,053	25,443	22,507	24,558
14	94,124	96,720	97,460	97,234	97,701	96,189	86,164	62,021	38,812	24,949	22,639	24,583
15	94,291	96,720	97,396	97,267	97,557	96,173	85,513	61,333	38,307	24,609	22,685	24,575
16	94,337	96,687	97,058	97,138	97,331	96,060	84,892	60,158	37,589	24,507	22,847	24,600
17	94,489	97,041	96,848	97,138	97,138	95,947	84,357	59,181	36,737	24,287	23,234	24,736
18	94,687	97,331	96,655	97,074	96,929	95,963	83,706	58,436	36,053	24,217	23,575	24,830
19	95,569	97,106	96,687	97,138	96,752	95,819	83,099	57,569	35,578	24,287	23,784	24,822
20	96,414	97,234	97,041	97,218	96,607	95,569	82,536	56,519	35,340	24,396	23,978	24,839
21	96,752	97,154	97,621	97,202	96,301	95,295	81,784	55,726	34,874	24,481	24,334	24,847
22	97,267	96,993	97,605	97,234	97,058	95,174	81,004	55,274	34,716	24,439	24,575	25,128
23	97,573	96,816	97,621	97,186	97,911	94,748	80,087	54,813	34,597	24,498	24,770	27,383
24	98,104	96,800	97,508	97,315	98,168	94,596	79,355	54,392	34,429	24,575	24,924	32,129
25	98,748	96,736	97,524	97,540	98,233	94,200	78,678	53,996	34,200	24,600	25,034	34,557
26	98,683	96,655	97,267	97,605	98,168	93,835	77,890	53,284	33,844	24,685	25,043	36,073
27	98,442	96,623	97,283	97,734	98,088	93,394	77,213	52,409	33,398	24,779	25,230	37,282
28	98,088	96,639	97,186	97,975	97,943	93,075	76,315	51,756	32,926	24,728	25,358	38,234
29	97,911	96,575		98,023	97,605	92,588	74,459	51,219	32,453	24,600	25,392	39,022
30	97,862	96,446		97,895	97,428	92,147	74,658	50,461	31,879	24,566	25,562	39,789
31	98,571	96,382		97,862		91,949		49,480	31,211		25,664	
Change	+11,367	-2,189	+804	+676	-434	-5,479	-17,291	-25,178	-18,269	-6,645	+1,098	+14,125
Equiv. Mgal/d	+366.7	-70.6	+28.7	+21.8	-14.5	-176.7	-576.4	-812.2	-589.3	-221.5	+35.4	+470.8
Equiv.ft^3/s	+567	-109	+44.4	+33.7	-22.4	-273	-892	-1,256	-912	-343	+54.8	+728

Change for year -47,415 Mgal | Equiv. for year -129.9 Mgal/d | Equiv. for year -201.0 ft^3/s

Table 12. - Storage in Neversink Reservoir, N.Y. for year ending November 30, 1991
(Storage in millions of gallons above elevation 1,319.00 ft. Add 525 million gallons for total contents above sill of outlet tunnel, elevation 1,314.00 ft.) Storage at spillway level is 34,941 million gallons.
(River Master daily operations record; gage reading at 0800)

Day	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov
1	29,092	34,018	29,973	29,733	32,260	31,944	34,057	30,905	25,006	16,497	8,371	6,312
2	29,088	34,052	29,883	29,710	32,203	32,118	33,964	30,753	24,780	16,066	8,121	6,229
3	29,030	33,959	29,851	29,878	32,108	32,274	33,901	30,602	24,531	15,644	7,930	6,167
4	29,151	33,925	29,756	30,542	32,033	32,377	33,804	30,492	24,300	15,326	7,708	6,098
5	29,878	33,780	29,701	31,397	31,887	32,463	33,741	30,387	24,039	14,952	7,603	6,002
6	30,064	33,634	29,674	31,658	31,808	32,600	33,659	30,241	23,801	14,577	7,325	5,932
7	30,186	33,485	29,715	31,939	31,724	32,810	33,620	30,119	23,581	14,206	7,046	5,842
8	30,292	33,269	29,946	32,269	31,658	32,986	33,558	29,986	23,350	13,840	6,895	5,760
9	30,324	33,067	30,013	32,410	31,560	33,105	33,456	29,810	23,147	13,454	6,746	5,673
10	30,373	32,881	30,068	32,477	31,537	33,249	33,350	29,638	23,024	13,055	6,545	5,603
11	30,383	32,691	30,082	32,519	31,429	33,374	33,240	29,491	22,847	12,693	6,321	5,519
12	30,414	32,472	30,068	32,515	31,294	33,490	33,149	29,293	22,634	12,304	6,219	5,484
13	30,410	32,283	30,023	32,557	31,118	33,577	33,086	29,114	22,310	12,003	6,143	5,413
14	30,419	32,085	30,013	32,557	30,970	33,664	32,962	28,973	21,957	11,781	6,041	5,339
15	30,383	31,925	30,028	32,572	30,850	33,770	32,881	28,773	21,626	11,567	5,938	5,260
16	30,405	31,799	30,019	32,552	30,845	33,809	32,776	28,548	21,344	11,363	6,152	5,186
17	30,424	31,775	29,941	32,515	30,854	33,939	32,647	28,329	21,116	11,155	6,454	5,113
18	30,433	31,733	29,919	32,491	30,864	34,037	32,529	28,097	20,791	10,916	6,635	5,033
19	30,593	31,615	29,869	32,444	30,845	34,062	32,434	27,866	20,544	10,699	6,766	4,925
20	30,689	31,490	29,832	32,468	30,804	34,130	32,307	27,597	20,372	10,520	6,824	4,824
21	30,758	31,364	29,946	32,358	30,799	34,179	32,179	27,344	20,105	10,317	6,833	4,708
22	31,271	31,169	29,964	32,269	31,076	34,219	32,066	27,094	19,829	10,121	6,830	4,651
23	31,752	31,026	29,964	32,165	31,299	34,276	31,948	26,945	19,551	9,891	6,803	5,475
24	32,250	30,818	29,937	32,137	31,406	34,281	31,803	26,732	19,257	9,687	6,772	6,062
25	32,933	30,693	29,905	32,137	31,532	34,335	31,663	26,511	18,957	9,508	6,712	6,321
26	33,177	30,533	29,860	32,141	31,583	34,365	31,551	26,295	18,675	9,362	6,643	6,488
27	33,182	30,337	29,810	32,094	31,625	34,370	31,461	26,114	18,405	9,210	6,592	6,674
28	33,192	30,195	29,728	32,184	31,648	34,330	31,327	25,896	18,119	8,997	6,535	6,843
29	33,177	30,119		32,288	31,663	34,243	31,188	25,662	17,816	8,799	6,466	6,991
30	33,182	30,037		32,335	31,794	34,150	31,035	25,441	17,422	8,577	6,373	7,127
31	33,746	30,013		32,297		34,086		25,221	16,951		6,297	
Change	+4,636	-3,733	-285	+2,569	-503	+2,292	-3,051	-5,814	-8,270	-8,374	-2,280	+830
Equiv. Mgal/d	+149.5	-120.4	-10.2	+82.9	-16.8	+73.9	-101.7	-187.5	-266.8	-279	-73.5	+27.7
Equiv.ft^3/s	+231	-186.3	-15.7	+128	-25.9	+114	-157	-290	-413	-432	-114	+42.8

Change for year -21,983 Mgal | Equiv. for year -60.2 Mgal/d | Equiv. for year -93.2 ft^3/s

Table 13. - Diversions by New Jersey; Daily mean discharge, in million gallons per day, of Delaware and Raritan Canal at Port Mercer, N.J. (01460440) for the year ending November 30, 1991.

DAY	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
1	89	81	85	92	90	97	94	95	100	98	82	70
2	90	87	86	92	94	95	96	93	99	98	83	68
3	91	87	87	85	94	98	97	92	98	98	84	67
4	67	87	88	21	93	100	96	96	98	96	83	68
5	80	88	88	101	93	100	97	94	98	99	82	67
6	84	88	90	82	96	76	96	95	98	98	79	64
7	89	89	88	82	92	82	97	94	97	92	84	63
8	92	91	87	88	92	96	96	92	96	96	90	65
9	91	89	89	91	91	100	95	95	98	99	92	68
10	90	84	89	92	91	100	96	95	76	96	87	70
11	91	89	89	92	94	98	94	95	91	98	83	69
12	92	25	89	94	99	96	91	94	98	95	74	72
13	92	73	90	94	97	98	94	73	100	92	74	74
14	93	81	87	97	100	95	96	87	100	86	73	72
15	92	82	87	90	95	93	95	89	98	87	73	73
16	79	70	87	89	96	92	95	92	100	84	63	73
17	89	72	87	90	99	92	96	91	98	81	71	72
18	81	78	90	90	96	95	85	94	100	81	66	71
19	85	79	86	87	98	92	81	97	94	83	65	70
20	89	87	84	89	96	93	89	98	85	87	66	70
21	87	76	88	90	69	92	92	100	89	85	67	69
22	90	87	89	92	68	92	91	102	96	85	69	69
23	90	87	91	90	90	96	92	102	99	84	69	59
24	75	87	91	84	92	94	96	103	98	85	68	64
25	84	91	92	89	79	96	95	98	101	82	68	63
26	87	93	94	92	92	102	96	99	101	67	68	64
27	89	94	91	92	92	103	96	103	100	79	63	74
28	90	90	92	88	98	104	95	103	96	85	69	78
29	87	89		90	98	102	96	105	98	84	70	79
30	75	88		87	98	96	93	101	98	84	70	79
31	74	82		89		95		100	96		71	
Total	2674	2571	2481	2721	2772	2960	2818	2967	2994	2664	2306	2084
Mean	86.3	82.9	88.6	87.8	92.4	95.5	93.9	95.7	96.6	88.8	74.4	69.5

Year total 32,012 $(ft^3/s)\cdot d$ Mean 87.7 ft^3/s

Table 14. - Diversions to New York City water supply
Million gallons per day for 24-hour period beginning 0800 local time
(River Master daily operation record)

Date 1990	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average June 1, 1990 to date	Date 1991	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average June 1, 1990 to date
Dec. 1	455	263	98	766	Jan. 1	459	205	337	771
2	452	261	98	766	2	455	204	366	772
3	325	205	97	765	3	453	203	270	772
4	453	293	95	766	4	436	203	326	773
5	287	182	98	765	5	454	203	351	774
6	301	197	94	764	6	454	203	305	775
7	452	298	93	764	7	454	0	372	775
8	451	298	90	765	8	454	0	306	775
9	451	298	101	765	9	455	10	357	776
10	452	298	95	766	10	454	0	308	776
11	444	291	95	766	11	454	0	333	776
12	170	179	96	764	12	455	0	331	776
13	297	183	92	763	13	455	0	282	775
14	292	187	119	762	14	451	0	243	775
15	457	298	101	763	15	454	0	241	775
16	457	298	99	763	16	454	0	244	774
17	454	262	97	764	17	454	0	237	774
18	454	262	95	764	18	456	0	237	774
19	454	262	112	764	19	456	0	239	773
20	454	262	80	764	20	456	0	242	773
21	448	262	100	765	21	455	0	238	773
22	447	262	95	765	22	454	0	237	772
23	447	262	96	765	23	461	0	242	772
24	456	204	141	765	24	455	0	244	772
25	458	203	144	765	25	455	0	238	771
26	458	203	295	766	26	455	0	239	771
27	450	204	215	767	27	455	0	245	771
28	456	204	258	767	28	456	189	139	771
29	457	205	230	768	29	455	197	151	771
30	456	204	249	769	30	455	198	170	771
31	458	205	275	769	31	455	127	147	771
Total	13,003	7,495	4,043			14,084	1,942	8,217	

Table 14. - Diversions to New York City water supply - continued
Million gallons per day for 24-hour period beginning 0800 local time
(River Master daily operation record)

Date 1991	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average June 1, 1990 to date	Date 1991	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average June 1, 1990 to date
Feb. 1	455	8	146	770	Mar. 1	454	140	143	762
2	455	0	134	770	2	454	196	143	762
3	455	0	147	769	3	455	196	145	762
4	455	143	152	769	4	429	5	146	761
5	451	198	148	769	5	454	0	146	761
6	451	198	144	769	6	454	0	148	760
7	452	198	144	769	7	453	136	146	760
8	450	11	143	769	8	453	194	148	760
9	450	0	143	768	9	452	194	145	760
10	450	0	145	767	10	452	194	162	761
11	449	0	146	767	11	452	0	132	760
12	448	0	149	766	12	452	0	148	759
13	448	0	147	765	13	452	0	142	759
14	450	129	144	765	14	452	0	145	758
15	451	196	142	765	15	452	0	147	758
16	450	197	146	765	16	452	0	151	757
17	450	198	143	765	17	452	0	145	757
18	450	199	147	765	18	300	0	239	756
19	450	199	171	766	19	297	19	172	755
20	451	155	138	766	20	300	0	243	754
21	451	128	142	765	21	151	10	220	753
22	451	43	156	765	22	307	0	240	752
23	450	0	139	764	23	336	0	243	752
24	450	0	147	764	24	340	0	243	751
25	453	176	158	764	25	303	0	241	750
26	454	7	145	763	26	308	0	244	750
27	454	0	151	763	27	304	0	235	749
28	454	0	134	762	28	301	0	244	748
					29	302	0	240	748
					30	291	0	259	747
					31	298	0	223	746
Total	12,638	2,383	4,091			11,812	1,284	5,768	

Table 14. - Diversions to New York City water supply - continued
Million gallons per day for 24-hour period beginning 0800 local time
(River Master daily operation record)

Date 1991	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average June 1, 1990 to date	Date 1991	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average June 1, 1990 to date
Apr. 1	301	0	252	746	May 1	454	496	0	736
2	302	0	220	745	2	454	496	0	737
3	298	0	253	744	3	454	496	0	738
4	315	0	237	744	4	454	495	0	738
5	295	0	226	743	5	454	495	0	739
6	285	0	235	742	6	454	496	0	739
7	301	0	240	742	7	454	496	0	740
8	319	0	227	741	8	454	496	0	741
9	317	0	145	740	9	274	496	0	741
10	290	0	251	739	10	453	496	0	741
11	309	0	249	739	11	453	496	0	742
12	302	0	238	738	12	454	496	0	743
13	298	0	247	738	13	454	328	0	743
14	284	0	250	737	14	454	323	0	743
15	329	295	99	737	15	453	324	0	743
16	300	296	104	737	16	455	324	0	743
17	293	295	96	737	17	455	436	0	743
18	310	295	99	737	18	454	496	0	744
19	303	295	100	736	19	453	496	0	745
20	300	295	93	736	20	454	496	0	745
21	294	295	101	736	21	455	322	0	745
22	309	295	96	736	22	455	323	0	745
23	301	296	94	736	23	453	295	0	745
24	302	296	95	736	24	454	322	0	745
25	309	296	69	736	25	454	322	0	746
26	294	295	97	736	26	454	322	0	746
27	283	295	97	735	27	454	322	94	746
28	280	295	94	735	28	454	321	83	746
29	453	325	0	735	29	455	321	94	747
30	454	436	0	736	30	452	321	97	747
					31	455	320	92	747
Total	9,330	4,895	4,604			13,896	12,684	460	

Table 14. - Diversions to New York City water supply - continued
Million gallons per day for 24-hour period beginning 0800 local time
(River Master daily operation record)

Date 1991	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average June 1, 1991 to date	Date 1991	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average June 1, 1991 to date
June 1	455	196	92	743	July 1	455	196	95	742
2	455	196	113	754	2	454	203	93	743
3	456	200	101	755	3	451	199	93	743
4	455	200	97	754	4	454	200	94	743
5	455	201	99	754	5	454	200	94	743
6	468	200	0	740	6	454	200	93	743
7	454	200	94	741	7	454	195	97	743
8	454	200	94	742	8	455	193	144	744
9	454	200	97	743	9	455	147	143	744
10	454	199	94	743	10	454	196	141	746
11	454	199	95	744	11	429	216	145	747
12	454	200	91	744	12	454	203	142	748
13	454	199	100	745	13	453	219	142	749
14	453	199	92	745	14	453	219	143	751
15	454	199	95	745	15	453	200	191	753
16	454	200	94	745	16	454	199	195	755
17	454	195	93	745	17	454	147	197	756
18	370	168	94	739	18	454	213	196	758
19	454	201	93	739	19	454	214	191	760
20	455	187	98	739	20	455	214	236	763
21	455	196	94	739	21	454	214	199	765
22	454	198	100	740	22	454	166	200	766
23	454	236	95	742	23	454	211	202	768
24	453	199	99	742	24	453	206	194	770
25	454	172	71	740	25	453	208	202	771
26	454	202	93	741	26	452	208	194	773
27	454	201	95	741	27	452	208	211	775
28	455	202	95	742	28	451	208	195	776
29	455	201	98	742	29	451	208	206	777
30	454	201	95	742	30	452	209	192	779
					31	453	154	193	779
Total	13,558	5,947	2,761			14,032	6,173	5,053	

Table 14. - Diversions to New York City water supply - continued
Million gallons per day for 24-hour period beginning 0800 local time
(River Master daily operation record)

Date 1991	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average June 1, 1991 to date	Date 1991	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date June 1 to Sept. 12 or Sept. 13 - 30, 1991
Aug. 1	453	209	195	780	Sept. 1	452	0	425	796
2	453	209	195	782	2	451	0	415	797
3	452	209	198	783	3	454	0	286	796
4	452	208	203	784	4	454	0	365	797
5	454	196	195	785	5	454	0	358	797
6	454	212	198	786	6	453	0	362	797
7	454	212	211	787	7	453	0	349	797
8	454	212	195	789	8	453	0	357	797
9	454	212	198	790	9	456	0	364	797
10	454	212	199	791	10	456	0	354	797
11	454	212	203	792	11	455	0	372	798
12	455	212	316	794	12	454	0	288	797
13	454	18	319	794	13	453	0	205	658
14	454	0	308	794	14	453	0	204	658
15	332	298	283	795	15	453	0	208	659
16	239	94	215	792	16	453	0	205	659
17	400	0	295	791	17	455	0	201	658
18	455	0	298	791	18	454	0	209	659
19	455	0	272	790	19	454	0	213	660
20	454	306	310	793	20	455	0	207	660
21	454	315	306	797	21	455	0	199	660
22	454	87	289	797	22	455	0	208	660
23	454	0	290	796	23	455	0	209	660
24	454	0	297	796	24	454	0	206	660
25	454	0	275	795	25	453	0	209	660
26	455	0	254	794	26	303	0	196	649
27	454	0	265	793	27	447	0	206	649
28	454	0	265	792	28	452	0	209	650
29	454	0	396	793	29	452	0	209	651
30	454	0	450	794	30	452	0	216	652
31	453	0	440	795					
Total	13,680	3,633	8,333			13,453	0	8,014	

Table 14. - Diversions to New York City water supply - continued
Million gallons per day for 24-hour period beginning 0800 local time
(River Master daily operation record)

Date 1991	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average to date Sept. 13- Oct. 10 or Oct. 11-31, 1991	Date 1991	East Delaware Tunnel	West Delaware Tunnel	Never-sink Tunnel	Average Oct. 11, 1991 to date
Oct.. 1	453	0	212	652	Nov. 1	453	0	111	549
2	454	0	196	652	2	453	0	102	549
3	453	0	210	653	3	453	0	105	550
4	282	0	85	640	4	452	0	117	550
5	453	197	272	652	5	451	0	101	551
6	453	190	295	664	6	452	0	107	551
7	296	0	148	655	7	453	0	101	551
8	308	1	144	647	8	453	0	106	551
9	452	199	203	655	9	453	0	108	552
10	453	199	219	663	10	453	0	99	552
11	454	0	118	572	11	453	0	105	552
12	454	0	101	564	12	452	0	109	552
13	453	0	108	563	13	452	0	113	552
14	453	0	106	562	14	452	0	110	553
15	377	0	109	547	15	454	0	109	553
16	443	0	108	547	16	454	0	109	553
17	411	0	107	543	17	454	0	106	553
18	453	0	106	545	18	453	0	140	554
19	452	0	99	546	19	453	0	141	555
20	452	0	102	547	20	453	0	141	556
21	453	0	102	547	21	453	0	140	557
22	454	0	105	548	22	453	0	140	558
23	454	0	104	549	23	456	0	140	559
24	454	0	104	550	24	457	0	135	560
25	453	0	99	550	25	452	0	92	559
26	472	0	107	552	26	453	0	0	557
27	453	0	100	552	27	453	0	0	555
28	453	0	105	552	28	453	0	0	553
29	452	0	108	553	29	453	0	0	551
30	452	0	113	553	30	453	0	0	549
31	452	0	0	548					
Total	13,461	786	4,095			13,592	0	2,887	

Table 15. - New York City Reservoir release design data
(River Master daily operation record)

Advance estimate of discharge of Delaware River at Montague exclusive of New York City reservoir releases							Indicated	Balancing	Directed	Computation of the balancing adjustment					
	Powerplant release forecasts		Uncontrolled runoff							Adjusted directed release		Actutal deficiency		Cumulative	Balancing
Date of advance estimate	Lake Wallenpaupack ft^3/s	Rio Reservoir ft^3/s	Present conditions ft^3/s	Weather adjustment ft^3/s	Date	Discharge ft^3/s	deficiency ft^3/s	adjustment ft^3/s	release ft^3/s	Daily ft^3/s	Cumulative $(ft^3/s)\cdot d$	Daily ft^3/s	Cumulative $(ft^3/s)\cdot d$	difference $(ft^3/s)\cdot d$	adjustment (ft^3/s)
1990/91	1	2	3	4		5	6	7	8	9	10	11	12	13	14

MONTAGUE DESIGN RATE = 1,850 ft^3/s DECEMBER 1,1990 TO MARCH 14, 1991
1,750 ft^3/s MARCH 15 TO JUNE 14

The estimated Montague discharge was greater than the Montague design rate Dec. 1,990 to May 23, 1991

May 21	0	0	1,343	0	May 24	1,343	407	407
22	0	0	1,226	44	25	1,270	480	480
23	0	0	1,173	57	26	1,230	520	520
24	0	0	1,058	172	27	1,230	520	520
25	0	0	1,017	157	28	1,174	576	576
26	0	0	961	185	29	1,146	604	604
27	0	284	944	189	30	1,417	333	333
28	0	284	1,117	62	31	1,463	287	287

Col. 1 - Furnished by power company.
Col. 2 - Furnished by power company.
Col. 3 - Computed from index stations.
Col. 4 - Computed increase in runoff based on weather forecasts.
Col. 5 = Col. 1 + Col. 2 + Col. 3 + Col. 4.
Col. 6 = Design rate - Col. 5, when positive; otherwise Co. 6 = 0.
Col. 7 = Col. 14 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Col. 7, from Table 16.
Col. 10 = Summation of Col. 9.
Col. 11 = Design rate - (Col. 9 + Col. 10 from Table 16), when positive; otherwise Col. 11 = 0.
Col. 12 = Summation of Col. 11.
Col. 13 = Col. 10 - Col. 12.
Col. 14 = Col. 13 divided by minus 10, limited to ±100.

Note:--Cols. 9-14 are used only for the computation of the balancing adjustment June 15 to Oct. 13.

Table 15. - New York City Reservoir release design data - continued
(River Master daily operation record)

Date of advance estimate	Advance estimate of discharge of Delaware River at Montague exclusive of New York City reservoir releases: Powerplant release forecasts: Lake Wallenpaupack ft^3/s	Powerplant release forecasts: Rio Reservoir ft^3/s	Uncontrolled runoff: Present conditions ft^3/s	Uncontrolled runoff: Weather adjustment ft^3/s	Date	Discharge ft^3/s	Indicated deficiency ft^3/s	Balancing adjustment ft^3/s	Directed release ft^3/s	Computation of the balancing adjustment: Adjusted directed release: Daily ft^3/s	Adjusted directed release: Cumulative (ft^3/s)-d	Actutal deficiency: Daily ft^3/s	Actutal deficiency: Cumulative (ft^3/s)-d	Cumulative difference (ft^3/s)-d	Balancing adjustment (ft^3/s)
1991	1	2	3	4		5	6	7	8	9	10	11	12	13	14
May 29	0	124	1,052	28	June 1	1,204	546		546						
30	0	0	934	419	2	1,353	397		397						
31	0	170	2,060	38	3	2,268	0		0						
June 1	0	340	1,867	0	4	2,207	0		0						
2	0	142	1,274	0	5	1,416	334		334						
3	0	142	1,039	0	6	1,181	569		569						
4	0	142	1,241	0	7	1,383	367		367						
5	0	142	1,157	0	8	1,299	451		451						
6	0	0	990	0	9	990	760		760						
7	0	71	815	0	10	886	864		864						
8	0	142	824	0	11	966	784		784						
9	0	142	720	0	12	862	888		888						
10	0	0	684	0	13	684	1,066		1,066						
11	0	0	591	105	14	696	1,054		1,054						
						MONTAGUE DESIGN RATE = 1,850 ft^3/s JUNE 15 TO JULY 20										
12	0	0	656	83	15	739	1,111		1,111	1,108	1,108	938	938	170	-17
13	0	0	823	0	16	823	1,027		1,027	1,025	2,133	795	1,733	400	-40
14	0	0	743	107	17	850	1,000		1,000	998	3,131	978	2,711	420	-42
15	0	142	666	185	18	993	857		857	867	3,998	987	3,698	300	-30
16	0	106	633	81	19	820	1,030	-17	1,013	1,013	5,011	1,043	4,741	270	-27
17	0	213	629	0	20	842	1,008	-40	968	974	5,985	1,074	5,815	170	-17
18	0	213	565	26	21	804	1,046	-42	1,004	1,012	6,997	1,012	6,827	170	-17
19	0	0	605	0	22	605	1,245	-30	1,215	1,227	8,224	1,077	7,904	320	-32
20	0	0	616	0	23	616	1,234	-27	1,207	1,208	9,432	1,138	9,042	390	-39
21	0	0	567	0	24	567	1,283	-17	1,266	1,269	10,701	1,239	10,281	420	-42
22	0	106	521	80	25	707	1,143	-17	1,126	1,128	11,829	1,278	11,559	270	-27
23	0	177	533	0	26	710	1,140	-32	1,108	1,113	12,942	1,293	12,852	90	-9
24	0	213	504	0	27	717	1,133	-39	1,094	1,098	14,040	1,258	14,110	-70	+7
25	0	284	476	0	28	760	1,090	-42	1,048	1,055	15,095	1,215	15,325	-230	+23
26	0	71	443	7	29	521	1,329	-27	1,302	1,301	16,396	1,091	16,416	-20	+2
27	0	0	419	0	30	419	1,431	-9	1,422	1,425	17,821	1,455	17,871	-50	+5

Col. 1 - Furnished by power company.
Col. 2 - Furnished by power company.
Col. 3 - Computed from index stations.
Col. 4 - Computed increase in runoff based on weather forecasts.
Col. 5 = Col. 1 + Col. 2 + Col. 3 + Col. 4.

Col. 6 = Design rate - Col. 5, when positive; otherwise Co. 6 = 0.
Col. 7 = Col. 14 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Col. 7, from Table 16.
Col. 10 = Summation of Col. 9.

Col. 11 = Design rate - (Col. 9 + Col. 10 from Table 16), when positive; otherwise Col. 11 = 0.
Col. 12 = Summation of Col. 11.
Col. 13 = Col. 10 - Col. 12.
Col. 14 = Col. 13 divided by minus 10, limited to ±100.

Note:--Cols. 9-14 are used only for the computation of the balancing adjustment June 15 to Oct. 13.

Table 15. - New York City Reservoir release design data - continued
(River Master daily operation record)

Date of advance estimate	Advance estimate of discharge of Delaware River at Montague exclusive of New York City reservoir releases: Powerplant release forecasts: Lake Wallenpaupack ft³/s	Powerplant release forecasts: Rio Reservoir ft³/s	Uncontrolled runoff: Present conditions ft³/s	Uncontrolled runoff: Weather adjustment ft³/s	Date	Discharge ft³/s	Indicated deficiency ft³/s	Balancing adjustment ft³/s	Directed release ft³/s	Computation of the balancing adjustment: Adjusted directed release: Daily ft³/s	Adjusted directed release: Cumulative (ft³/s)·d	Actutal deficiency: Daily ft³/s	Actutal deficiency: Cumulative (ft³/s)·d	Cumulative difference (ft³/s)·d	Balancing adjustment (ft³/s)
1991	1	2	3	4		5	6	7	8	9	10	11	12	13	14
June 28	0	177	408	0	July 1	585	1,265	+7	1,272	1,273	19,094	1,433	19,304	-210	+21
29	0	248	394	47	2	689	1,161	+23	1,184	1,189	20,283	1,349	20,653	-370	+37
30	0	142	367	0	3	509	1,341	+2	1,343	1,346	21,629	1,256	21,909	-280	+28
July 1	0	0	352	0	4	352	1,498	+5	1,503	1,506	23,135	1,426	23,335	-200	+20
2	0	106	341	21	5	468	1,382	+21	1,403	1,408	24,543	1,418	24,753	-210	+21
3	0	35	367	16	6	418	1,432	+37	1,469	1,470	26,013	1,420	26,173	-160	+16
4	0	0	376	84	7	460	1,390	+28	1,418	1,425	27,438	1,425	27,598	-160	+16
5	0	177	384	26	8	587	1,263	+20	1,283	1,277	28,715	1,317	28,915	-200	+20
6	0	284	425	25	9	734	1,116	+21	1,137	1,141	29,856	1,231	30,146	-290	+29
7	0	213	408	124	10	745	1,105	+16	1,121	1,122	30,978	1,462	31,608	-630	+63
8	0	177	399	37	11	613	1,237	+16	1,253	1,251	32,229	1,531	33,139	-910	+91
9	0	0	369	0	12	369	1,481	+20	1,501	1,506	33,735	1,526	34,665	-930	+93
10	0	0	324	0	13	324	1,526	+29	1,555	1,552	35,287	1,652	36,317	-1,030	+100
11	0	0	321	0	14	321	1,529	+63	1,592	1,591	36,878	1,501	37,818	-940	+94
12	0	0	291	90	15	381	1,469	+91	1,560	1,560	38,438	1,430	39,248	-810	+81
13	230	0	308	39	16	577	1,273	+93	1,366	1,372	39,810	1,152	40,400	-590	+59
14	0	0	330	0	17	330	1,520	+100	1,620	1,621	41,431	1,371	41,771	-340	+34
15	0	177	285	0	18	462	1,388	+94	1,482	1,486	42,917	1,446	43,217	-300	+30
16	230	177	274	0	19	681	1,169	+81	1,250	1,248	44,165	1,068	44,285	-120	+12
17	230	160	241	0	20	631	1,219	+59	1,278	1,278	45,443	918	45,203	240	-24
						MONTAGUE DESIGN RATE = 1,750 ft³/s JULY 21 TO SEPTEMBER 15										
18	0	0	209	0	21	209	1,541	+34	1,575	1,585	47,028	1,495	46,698	330	-33
19	0	113	199	0	22	312	1,438	+30	1,468	1,466	48,494	1,276	47,974	520	-50
20	460	284	239	0	23	983	767	+12	779	785	49,279	565	48,539	740	-50
21	460	284	219	0	24	963	787	-24	763	771	50,050	561	49,100	950	-50
22	472	177	251	100	25	1,000	750	-33	717	720	50,770	570	49,670	1,100	-50
23	472	177	387	60	26	1,096	654	-50	604	602	51,372	692	50,362	1,010	-50
24	472	0	351	12	27	835	915	-50	865	873	52,245	823	51,185	1,060	-50
25	0	0	302	53	28	355	1,395	-50	1,345	1,348	53,593	1,278	52,463	1,130	-50
26	0	0	308	313	29	621	1,129	-50	1,079	1,079	54,672	1,159	53,622	1,050	-50
27	472	0	418	0	30	890	860	-50	810	813	55,485	913	54,535	950	-50
28	472	0	363	74	31	909	841	-50	791	791	56,276	911	55,416	830	-50

Col. 1 - Furnished by power company.
Col. 2 - Furnished by power company.
Col. 3 - Computed from index stations.
Col. 4 - Computed increase in runoff based on weather forecasts.
Col. 5 = Col. 1 + Col. 2 + Col. 3 + Col. 4.

Col. 6 = Design rate - Col. 5, when positive; otherwise Co. 6 = 0.
Col. 7 = Col. 14 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Col. 7, from Table 16.
Col. 10 = Summation of Col. 9.

Col. 11 = Design rate - (Col. 9 + Col. 10 from Table 16), when positive; otherwise Col. 11 = 0.
Col. 12 = Summation of Col. 11.
Col. 13 = Col. 10 - Col. 12.
Col. 14 = Col. 13 divided by minus 10, limited to ±100 July 1-17 and ±50 thereafter.

Note:--Cols. 9-14 are used only for the computation of the balancing adjustment June 15 to Oct. 13.

Table 15. - New York City Reservoir release design data - continued
(River Master daily operation record)

Advance estimate of discharge of Delaware River at Montague exclusive of New York City reservoir releases							Indicated	Balancing	Directed	Computation of the balancing adjustment					
	Powerplant release forecasts		Uncontrolled runoff							Adjusted directed release		Actutal deficiency		Cumulative	Balancing
Date of advance estimate	Lake Wallenpaupack	Rio Reservoir	Present conditions	Weather adjustment	Date	Discharge	deficiency	adjustment	release	Daily	Cumulative	Daily	Cumulative	difference	adjustment
	ft^3/s	ft^3/s	ft^3/s	ft^3/s		ft^3/s	ft^3/s	ft^3/s	ft^3/s	ft^3/s	$(ft^3/s)\cdot d$	ft^3/s	$(ft^3/s)\cdot d$	$(ft^3/s)\cdot d$	(ft^3/s)
1991	1	2	3	4		5	6	7	8	9	10	11	12	13	14
July 29	0	0	319	62	Aug. 1	381	1,369	-50	1,319	1,320	57,596	1,320	56,766	830	-50
30	0	0	298	13	2	311	1,439	-50	1,389	1,394	58,990	1,374	58,140	850	-50
31	0	0	298	0	3	298	1,452	-50	1,402	1,398	60,388	1,488	59,628	760	-50
Aug. 1	0	0	275	0	4	275	1,475	-50	1,425	1,422	61,810	1,462	61,090	720	-50
2	0	0	251	0	5	251	1,499	-50	1,449	1,449	63,259	1,409	62,499	760	-50
3	0	0	218	0	6	218	1,532	-50	1,482	1,480	64,739	1,440	63,939	800	-50
4	0	113	194	0	7	307	1,443	-50	1,393	1,391	66,130	1,341	65,280	850	-50
5	0	0	250	0	8	250	1,500	-50	1,450	1,449	67,579	1,439	66,719	860	-50
6	230	0	227	0	9	457	1,293	-50	1,243	1,247	68,826	1,177	67,896	930	-50
7	0	0	232	17	10	249	1,501	-50	1,451	1,453	70,279	1,343	69,239	1,040	-50
8	0	0	208	275	11	483	1,267	-50	1,217	1,223	71,502	1,153	70,392	1,110	-50
9	0	0	187	428	12	615	1,135	-50	1,085	1,087	72,589	1,157	71,549	1,040	-50
10	592	71	529	0	13	1,192	465	-50	415	418	73,007	458	72,007	1,000	-50
11	592	106	541	0	14	1,239	511	-50	461	464	73,471	634	72,641	830	-50
12	769	134	336	0	15	1,239	511	-50	461	463	73,934	323	72,964	970	-50
13	414	106	233	0	16	743	1,007	-50	957	957	74,891	697	73,661	1,230	-50
14	592	0	264	0	17	856	894	-50	844	845	75,736	405	74,066	1,670	-50
15	0	0	262	40	18	302	1,448	-50	1,398	1,407	77,143	1,377	75,443	1,700	-50
16	0	71	298	16	19	385	1,365	-50	1,315	1,305	78,448	945	76,388	2,060	-50
17	0	106	309	130	20	545	1,205	-50	1,155	1,154	79,602	944	77,332	2,270	-50
18	0	142	302	554	21	998	752	-50	702	700	80,302	960	78,292	2,010	-50
19	0	142	364	682	22	1,188	562	-50	512	512	80,814	717	79,009	1,805	-50
20	0	0	634	797	23	1,431	369	-50	319	319	81,133	0	79,009	2,124	-50
21	0	0	864	900	24	1,764	0	-50	0	0	81,133	412	79,421	1,712	-50
22	0	0	1,124	0	25	1,124	626	-50	576	578	81,711	1,258	80,679	1,032	-50
23	0	113	759	0	26	872	878	-50	828	838	82,549	1,228	81,907	642	-50
24	0	170	547	0	27	717	1,033	-50	983	980	83,529	1,080	82,987	542	-50
25	0	170	459	0	28	629	1,121	-50	1,071	1,076	84,605	1,066	84,053	552	-50
26	0	170	351	0	29	521	1,229	-50	1,179	1,176	85,781	1,106	85,159	622	-50
27	0	142	334	0	30	476	1,274	-50	1,224	1,227	87,008	1,157	86,316	692	-50
28	0	0	316	0	31	316	1,434	-50	1,384	1,382	88,390	1,352	87,668	722	-50

Col. 1 - Furnished by power company.
Col. 2 - Furnished by power company.
Col. 3 - Computed from index stations.
Col. 4 - Computed increase in runoff based on weather forecasts.
Col. 5 = Col. 1 + Col. 2 + Col. 3 + Col. 4.

Col. 6 = Design rate - Col. 5, when positive; otherwise Co. 6 = 0.
Col. 7 = Col. 14 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Col. 7, from Table 16.
Col. 10 = Summation of Col. 9.

Col. 11 = Design rate - (Col. 9 + Col. 10 from Table 16), when positive; otherwise Col. 11 = 0.
Col. 12 = Summation of Col. 11.
Col. 13 = Col. 10 - Col. 12.
Col. 14 = Col. 13 divided by minus 10, limited to ±50.

Note:--Cols. 9-14 are used only for the computation of the balancing adjustment June 15 to Oct. 13.

Table 15. - New York City Reservoir release design data - continued
(River Master daily operation record)

Advance estimate of discharge of Delaware River at Montague exclusive of New York City reservoir releases							Indicated	Balancing	Directed	Computation of the balancing adjustment					
	Powerplant release forecasts		Uncontrolled runoff							Adjusted directed release		Actutal deficiency		Cumulative	Balancing
Date of advance estimate	Lake Wallenpaupack	Rio Reservoir	Present conditions	Weather adjustment	Date	Discharge	deficiency	adjustment	release	Daily	Cumulative	Daily	Cumulative	difference	adjustment
	ft^3/s	ft^3/s	ft^3/s	ft^3/s		ft^3/s	ft^3/s	ft^3/s	ft^3/s	ft^3/s	$(ft^3/s)\cdot d$	ft^3/s	$(ft^3/s)\cdot d$	$(ft^3/s)\cdot d$	(ft^3/s)
1991	1	2	3	4		5	6	7	8	9	10	11	12	13	14
Aug. 29	0	0	300	0	Sept. 1	300	1,450	-50	1,400	1,407	89,797	1,507	89,175	622	-50
30	0	0	297	3	2	300	1,450	-50	1,400	1,401	91,198	1,591	90,766	432	-43
31	0	0	275	9	3	284	1,466	-50	1,416	1,423	92,621	1,563	92,329	292	-29
Sept. 1	0	0	259	0	4	259	1,491	-50	1,441	1,437	94,058	1,537	93,866	192	-19
2	0	0	249	0	5	249	1,501	-50	1,451	1,448	95,506	1,418	95,284	222	-22
3	0	0	236	7	6	243	1,507	-43	1,464	1,467	96,973	1,487	96,771	202	-20
4	0	0	228	37	7	265	1,485	-29	1,456	1,461	98,434	1,521	98,292	142	-14
5	0	0	195	0	8	195	1,555	-19	1,536	1,541	99,975	1,511	99,803	172	-17
6	0	0	191	0	9	191	1,559	-22	1,537	1,552	101,527	1,582	101,385	142	-14
7	231	0	191	0	10	422	1,328	-20	1,308	1,325	102,852	1,235	102,620	232	-23
8	231	0	185	0	11	416	1,334	-14	1,320	1,323	104,175	1,343	103,963	212	-21
9	231	0	194	22	12	447	1,303	-17	1,286	1,289	105,464	1,349	105,312	152	-15
10	231	0	189	31	13	451	1,299	-14	1,285	1,286	106,750	1,336	106,648	102	-10
11	231	0	184	0	14	415	1,335	-23	1,312	1,318	108,068	1,378	108,026	42	-4
12	0	0	169	48	15	217	1,533	-21	1,512	1,507	109,575	1,607	109,633	-58	+6
MONTAGUE DESIGN RATE = 1,655 ft^3/s SEPTEMBER 16 - OCTOBER 12															
13	0	0	155	0	16	155	1,500	-15	1,485	1,483	111,058	1,358	110,991	67	-7
14	825	0	164	0	17	989	666	-10	656	650	111,708	85	111,076	632	-50
15	825	0	156	0	18	981	674	-4	670	671	112,379	406	111,482	897	-50
16	825	0	201	0	19	1,026	629	+6	635	637	113,016	122	111,604	1,412	-50
17	825	0	203	9	20	1,037	618	-7	611	611	113,627	6	111,610	2,017	-50
18	825	0	193	52	21	1,070	585	-50	535	537	114,164	0	111,610	2,554	-50
19	0	0	759	83	22	842	813	-50	763	759	114,923	924	112,534	2,389	-50
20	0	0	720	0	23	720	935	-50	885	878	115,801	1,153	113,687	2,114	-50
21	825	0	521	0	24	1,346	309	-50	259	256	116,057	0	113,687	2,370	-50
22	825	0	426	63	25	1,314	341	-50	291	288	116,345	0	113,687	2,658	-50
23	825	0	364	291	26	1,480	175	-50	125	125	116,470	0	113,687	2,783	-50
24	825	0	364	452	27	1,641	9	-50	0	0	116,470	0	113,687	2,783	-50
25	825	0	486	81	28	1,392	263	-50	213	216	116,686	271	113,958	2,728	-50
26	0	0	616	0	29	616	1,039	-50	989	993	117,679	1,398	115,356	2,323	-50
27	0	0	539	0	30	539	1,116	-50	1,066	1,064	118,743	1,269	116,625	2,118	-50

Col. 1 - Furnished by power company.
Col. 2 - Furnished by power company.
Col. 3 - Computed from index stations.
Col. 4 - Computed increase in runoff based on weather forecasts.
Col. 5 = Col. 1 + Col. 2 + Col. 3 + Col. 4.
Col. 6 = Design rate - Col. 5, when positive; otherwise Co. 6 = 0.
Col. 7 = Col. 14 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Col. 7, from Table 16.
Col. 10 = Summation of Col. 9.
Col. 11 = Design rate - (Col. 9 + Col. 10 from Table 16), when positive; otherwise Col. 11 = 0.
Col. 12 = Summation of Col. 11.
Col. 13 = Col. 10 - Col. 12.
Col. 14 = Col. 13 divided by minus 10, limited to ±50.

Note:--Cols. 9-14 are used only for the computation of the balancing adjustment June 15 to Oct. 13.

Table 15. - New York City Reservoir release design data - continued
(River Master daily operation record)

Date of advance estimate	Advance estimate of discharge of Delaware River at Montague exclusive of New York City reservoir releases: Powerplant release forecasts: Lake Wallenpaupack ft^3/s	Powerplant release forecasts: Rio Reservoir ft^3/s	Uncontrolled runoff: Present conditions ft^3/s	Uncontrolled runoff: Weather adjustment ft^3/s	Date	Discharge ft^3/s	Indicated deficiency ft^3/s	Balancing adjustment ft^3/s	Directed release ft^3/s	Computation of the balancing adjustment: Adjusted directed release: Daily ft^3/s	Adjusted directed release: Cumulative $(ft^3/s)\cdot d$	Actutal deficiency: Daily ft^3/s	Actutal deficiency: Cumulative $(ft^3/s)\cdot d$	Cumulative difference $(ft^3/s)\cdot d$	Balancing adjustment (ft^3/s)
1991	1	2	3	4		5	6	7	8	9	10	11	12	13	14
Sept. 28	604	0	476	0	Oct. 1	1,080	575	-50	525	524	19,267	429	17,054	2,213	-50
29	604	0	411	0	2	1,015	640	-50	590	588	19,855	553	17,607	2,248	-50
30	825	0	357	0	3	1,182	473	-50	423	424	20,279	419	18,026	2,253	-50
Oct. 1	825	0	328	0	4	1,153	502	-50	452	448	20,727	423	18,449	2,278	-50
2	825	0	325	37	5	1,187	468	-50	418	424	21,151	449	18,898	2,253	-50
3	0	0	233	0	6	223	1,422	-50	1,372	1,372	22,523	1,550	20,448	2,075	-50
4	0	0	259	0	7	259	1,396	-50	1,346	1,340	23,863	1,205	21,653	2,210	-50
5	825	0	296	63	8	1,184	471	-50	421	416	24,279	61	21,714	2,565	-50
6	825	0	362	0	9	1,187	468	-50	418	423	24,702	338	22,052	2,650	-50
7	825	0	430	0	10	1,255	400	-50	350						
8	825	0	417	13	11	1,255	400	-50	350						
9	825	0	376	21	12	1,222	433	-50	383						
MONTAGUE DESIGN RATE 1,100 ft^3/s OCTOBER 13 THROUGH NOVEMBER 6, 1991 EXCEPT FOR A 32-HOUR PERIOD ON OCTOBER 13-14; OCTOBER 20-21; AND OCTOBER 27-28, WHICH WAS 1,655 ft^3/s															
10	0	0	374	71	13	445	1,210	-50	1,160						
11	0	0	391	270	14	661	624		624						
12	291	0	627	0	15	918	182		182						
13	0	0	618	0	16	618	482		482						
The estimated Montague discharge was greater than the Montague design rate October 17 to October 24, 1991															
22	0	0	893	0	25	893	207		207						
23	0	0	775	0	26	775	325		325						
24	0	0	737	0	27	737	918		918						
25	0	213	704	15	28	932	353		353						
26	0	213	661	0	29	874	226		226						
27	0	213	650	21	30	884	216		216						
28	0	213	633	0	31	846	254		254						

Col. 1 - Furnished by power company.
Col. 2 - Furnished by power company.
Col. 3 - Computed from index stations.
Col. 4 - Computed increase in runoff based on weather forecasts.
Col. 5 = Col. 1 + Col. 2 + Col. 3 + Col. 4.
Col. 6 = Design rate - Col. 5, when positive; otherwise Co. 6 = 0.
Col. 7 = Col. 14 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Col. 7, from Table 16.
Col. 10 = Summation of Col. 9.
Col. 11 = Design rate - (Col. 9 + Col. 10 from Table 16), when positive; otherwise Col. 11 = 0.
Col. 12 = Summation of Col. 11.
Col. 13 = Col. 10 - Col. 12.
Col. 14 = Col. 13 divided by minus 10, limited to ±50.

Note:--Cols. 9-14 are used only for the computation of the balancing adjustment June 15 to Oct. 13.

Table 15. - New York City Reservoir release design data - continued
(River Master daily operation record)

Date of advance estimate	Advance estimate of discharge of Delaware River at Montague exclusive of New York City reservoir releases: Powerplant release forecasts: Lake Wallenpaupack ft^3/s	Powerplant release forecasts: Rio Reservoir ft^3/s	Uncontrolled runoff: Present conditions ft^3/s	Uncontrolled runoff: Weather adjustment ft^3/s	Date	Discharge ft^3/s	Indicated deficiency ft^3/s	Balancing adjustment ft^3/s	Directed release ft^3/s	Computation of the balancing adjustment: Adjusted directed release: Daily ft^3/s	Adjusted directed release: Cumulative (ft^3/s)-d	Actutal deficiency: Daily ft^3/s	Actutal deficiency: Cumulative (ft^3/s)-d	Cumulative difference (ft^3/s)-d	Balancing adjustmen (ft^3/s)
1991	1	2	3	4		5	6	7	8	9	10	11	12	13	14
Oct. 29	0	213	594	0	Nov. 1	807	293		293						
30	0	106	575	0	2	681	419		419						
31	0	0	561	0	3	561	539		539						
Nov. 1	0	0	539	0	4	539	561		561						
2	0	0	507	0	5	507	593		593						
3	0	0	455	0	6	455	645		645						
						MONTAGUE DESIGN RATE = 1,500 ft^3/s NOVEMBER 7-9									
4	0	0	464	0	7	464	1,036		1,036						
5	0	0	441	0	8	441	1,059		1,059						
6	0	0	429	0	9	429	1,071		1,071						
						MONTAGUE DESIGN RATE = 1,350 ft^3/s NOVEMBER 10-17									
7	0	0	420	0	10	420	930		930						
8	0	0	420	54	11	474	876		876						
9	0	0	413	119	12	532	818		818						
10	0	0	408	287	13	695	655		655						
11	0	0	480	34	14	514	836		836						
12	0	0	837	14	15	851	499		499						
13	0	0	758	2	16	760	590		590						
14	0	0	759	106	17	865	485		485						
						MONTAGUE DESIGN RATE 1,100 ft^3/s NOVEMBER 18-30									
15	0	0	706	36	18	742	358		358						
16	0	0	793	0	19	793	307		307						
17	0	0	734	0	20	734	366		366						
18	0	0	713	16	21	729	371		371						
19	0	0	668	87	22	755	345		345						
20	0	0	698	281	23	979	121		121						
						The estimated Montague design rate was greater than the Montague design rate November 24-30									

Col. 1 - Furnished by power company.
Col. 2 - Furnished by power company.
Col. 3 - Computed from index stations.
Col. 4 - Computed increase in runoff based on weather forecasts.
Col. 5 = Col. 1 + Col. 2 + Col. 3 + Col. 4.

Col. 6 = Design rate - Col. 5, when positive; otherwise Co. 6 = 0.
Col. 7 = Col. 14 (4 days earlier).
Col. 8 = Design rate - Col. 5 + Col. 7, when positive; otherwise Col. 8 = 0.
Col. 9 = Col. 7, from Table 16.
Col. 10 = Summation of Col. 9.

Col. 11 = Design rate - (Col. 9 + Col. 10 from Table 16), when positive; otherwise Col. 11 = 0.
Col. 12 = Summation of Col. 11.
Col. 13 = Col. 10 - Col. 12.
Col. 14 = Col. 13 divided by minus 10, limited to ±50.

Table 16. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, NJ.
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount				Date			Date	Directed	Other				Daily	Cumul.
1990	1	2	3	4		5	6		7	8	9	10	11	12	13
Nov. 28	0	50	34	26	Nov. 30	785	333	Dec. 1	0	110	1,118	2,492	3,720	0	9,564
29	0	50	34	28	Dec. 1	226	64	2	0	112	290	2,428	2830	0	9,564
30	0	50	34	28	2	53	170	3	0	112	223	2,485	2,820	0	9,564
Dec. 1	0	50	34	28	3	1,417	706	4	0	112	2,123	12,365	14,600	0	9,564
2	0	50	34	28	4	1,593	699	5	0	112	2,292	23,896	26,300	0	9,564
3	0	50	34	28	5	889	727	6	0	112	1,616	13,772	15,500	0	9,564
4	0	50	34	28	6	997	631	7	0	112	1,628	9,760	11,500	0	9,564
5	0	50	34	28	7	800	705	8	0	112	1,505	7,633	9,250	0	9,564
6	0	51	36	28	8	0	386	9	0	115	386	6,789	7,290	0	9,564
7	0	51	36	28	9	0	617	10	0	115	617	6,098	6,830	0	9,564
8	0	51	36	28	10	939	518	11	0	115	1,457	5,078	6,650	0	9,564
9	0	51	36	28	11	926	394	12	0	115	1,320	4,425	5,860	0	9,564
10	0	51	36	28	12	959	333	13	0	115	1,292	4,043	5,450	0	9,564
11	0	51	36	28	13	931	571	14	0	115	1,502	3,733	5,350	0	9,564
12	0	51	36	28	14	813	351	15	0	115	1,164	3,361	4,640	0	9,564
13	0	51	36	28	15	220	500	16	0	115	720	3,135	3,970	0	9,564
14	0	51	36	28	16	333	447	17	0	115	780	3,785	4,680	0	9,564
15	0	51	36	28	17	924	401	18	0	115	1,325	4,110	5,550	0	9,564
16	0	51	36	28	18	926	460	19	0	115	1,386	8,599	10,100	0	9,564
17	0	51	36	25	19	947	535	20	0	112	1,482	9,106	10,700	0	9,564
18	0	51	36	25	20	846	684	21	0	112	1,530	7,468	9,110	0	9,564
19	0	51	36	25	21	816	549	22	0	112	1,365	8,193	9,670	0	9,564
20	0	51	34	25	22	468	443	23	0	110	911	9,079	10,100	0	9,564
21	0	51	32	26	23	549	737	24	0	109	1,286	12,405	13,800	0	9,564
22	0	51	32	26	24	823	645	25	0	109	1,468	15,623	17,200	0	9,564
23	0	51	32	26	25	573	354	26	0	109	927	12,764	13,800	0	9,564
24	0	51	32	26	26	825	496	27	0	109	1,321	9,670	11,100	0	9,564
25	0	51	32	26	27	584	479	28	0	109	1,063	8,338	9,510	0	9,564
26	0	53	32	25	28	822	699	29	0	110	1,521	7,699	9,330	0	9,564
27	0	53	32	25	29	468	652	30	0	110	1,120	6,980	8,210	0	9,564
28	0	53	32	25	30	565	273	31	0	110	838	16,252	17,200	0	9,564
Total	0	1,579	1,066	835		22,017	15,559		0	3,480	37,576	251,564	292,620		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.

Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.
Col. 10 = Col. 11 - Col. 7 - Co. 8 - Col. 9
Col. 11 = 24 hours of calendar day shown.

Col. 12= Col. 8 - 1,750 ft^3/s computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning October 1, 1990 = 9,762 (ft^3/d)-d

Table 16. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J. - continued
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled		Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount				Date			Date	Directed	Other			Total	Daily	Cumul.
1990/91	1	2	3	4		5	6		7	8	9	10	11	12	13
Dec. 29	0	53	32	25	Dec. 31	831	358	Jan. 1	0	110	1,189	16,001	17,300	0	9,564
30	0	53	32	25	Jan. 1	582	301	2	0	110	883	12,507	13,500	0	9,564
31	0	50	32	25	2	944	656	3	0	107	1,600	9,693	11,400	0	9,564
Jan. 1	0	51	32	25	3	986	443	4	0	108	1,429	8,563	10,100	0	9,564
2	0	50	32	25	4	981	621	5	0	107	1,602	6,951	8,660	0	9,564
3	0	48	32	25	5	792	599	6	0	105	1,391	6,024	7,520	0	9,564
4	0	48	32	25	6	565	531	7	0	105	1,096	5,919	7,120	0	9,564
5	0	48	32	25	7	944	582	8	0	105	1,526	4,799	6,430	0	9,564
6	0	48	32	25	8	966	567	9	0	105	1,533	4,282	5,920	0	9,564
7	0	48	32	25	9	825	504	10	0	105	1,329	4,056	5,490	0	9,564
8	0	51	32	25	10	540	642	11	0	108	1,182	4,130	5,420	0	9,564
9	0	48	32	25	11	456	486	12	0	105	942	3,573	4,620	0	9,564
10	0	51	36	28	12	959	333	13	0	115	1,292	4,043	5,450	0	9,564
11	0	48	32	25	13	579	687	14	0	105	1,266	3,779	5,150	0	9,564
12	0	48	32	25	14	918	447	15	0	105	1,365	3,490	4,960	0	9,564
13	0	48	32	25	15	922	592	16	0	105	1,514	3,681	5,250	0	9,564
14	0	48	32	25	16	944	582	17	0	105	1,526	5,389	7,020	0	9,564
15	0	48	32	25	17	916	631	18	0	105	1,547	7,218	8,870	0	9,564
16	0	48	32	25	18	830	617	19	0	105	1,447	5,808	7,360	0	9,564
17	0	48	32	25	19	468	316	20	0	105	784	5,171	6,060	0	9,564
18	0	48	32	25	20	614	458	21	0	105	1,072	5,423	6,600	0	9,564
19	0	48	32	25	21	1,080	571	22	0	105	1,651	4,494	6,250	0	9,564
20	0	48	32	25	22	1,209	489	23	0	105	1,698	3,577	5,380	0	9,564
21	0	48	32	25	23	1,036	301	24	0	105	1,337	3,408	4,850	0	9,564
22	0	48	32	25	24	938	394	25	0	105	1,332	3,773	5,210	0	9,564
23	0	48	32	25	25	827	199	26	0	105	1,026	3,279	4,410	0	9,564
24	0	48	32	25	26	460	0	27	0	105	460	3,135	3,700	0	9,564
25	0	48	32	25	27	587	60	28	0	105	647	3,348	4,100	0	9,564
26	0	48	32	25	28	943	309	29	0	105	1,252	3,383	4,740	0	9,564
27	0	48	32	25	29	970	553	30	0	105	1,523	3,072	4,700	0	9,564
28	0	48	32	25	30	936	282	31	0	105	1,218	3,837	5,160	0	9,564
Total	0	1,508	992	775		25,417	14,388		0	3,275	39,805	165,070	208,150		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.
Col. 3 - 24 hours ending 2400 one day later.

Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.
Col. 10 = Col. 11 - Col. 7 - Co. 8 - Col. 9
Col. 11 = 24 hours of calendar day shown.

Col. 12 = Col. 8 - 1,750 ft^3/s computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning October 1, 1990 = 9,762 $(ft^3/d)\cdot d$.

Table 16. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J. - continued
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount				Date			Date	Directed	Other				Daily	Cumul.
1991	1	2	3	4		5	6		7	8	9	10	11	12	13
Jan. 29	0	46	32	25	Jan. 31	829	245	Feb. 1	0	103	1,074	4,013	5,190	0	9,564
30	0	50	32	25	Feb. 1	467	277	2	0	107	744	3,469	4,320	0	9,564
31	0	50	32	25	2	230	199	3	0	107	429	3,134	3,670	0	9,564
Feb. 1	0	48	32	25	3	0	202	4	0	105	202	3,533	3,840	0	9,564
2	0	48	32	25	4	0	220	5	0	105	220	3,925	4,250	0	9,564
3	0	48	32	25	5	226	277	6	0	105	503	4,332	4,940	0	9,564
4	0	48	32	25	6	222	223	7	0	105	445	7,230	7,780	0	9,564
5	0	48	32	25	7	223	298	8	0	105	521	14,374	15,000	0	9,564
6	0	46	32	25	8	223	333	9	0	103	556	11,541	12,200	0	9,564
7	0	50	32	25	9	0	443	10	0	107	443	9,850	10,400	0	9,564
8	0	48	32	25	10	0	216	11	0	105	216	8,919	9,240	0	9,564
9	0	50	32	25	11	920	532	12	0	107	1,452	7,061	8,620	0	9,564
10	0	50	32	25	12	965	486	13	0	107	1,451	5,862	7,420	0	9,564
11	0	50	32	25	13	946	511	14	0	107	1,457	5,946	7,510	0	9,564
12	0	48	32	25	14	941	684	15	0	105	1,625	6,070	7,800	0	9,564
13	0	48	32	25	15	946	688	16	0	105	1,634	5,481	7,220	0	9,564
14	0	46	32	25	16	839	571	17	0	103	1,410	4,277	5,790	0	9,564
15	0	48	32	25	17	451	379	18	0	105	830	4,155	5,090	0	9,564
16	0	48	32	25	18	917	291	19	0	105	1,208	4,147	5,460	0	9,564
17	0	48	32	25	19	840	617	20	0	105	1,457	4,498	6,060	0	9,564
18	0	50	32	25	20	935	238	21	0	107	1,173	8,670	9,950	0	9,564
19	0	50	32	25	21	942	238	22	0	107	1,180	7,933	9,220	0	9,564
20	0	50	32	25	22	809	298	23	0	107	1,107	7,366	8,580	0	9,564
21	0	50	32	25	23	457	518	24	0	107	975	5,958	7,040	0	9,564
22	0	51	32	25	24	573	429	25	0	108	1,002	5,960	7,070	0	9,564
23	0	50	32	25	25	872	492	26	0	107	1,364	5,279	6,750	0	9,564
24	0	50	32	25	26	930	450	27	0	107	1,380	4,863	6,350	0	9,564
25	0	50	32	25	27	941	518	28	0	107	1,459	4,334	5,900	0	9,564
Total	0	1,367	896	700		16,644	10,873		0	2,963	27,517	172,180	202,660		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.

Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.
Col. 10 = Col. 11 - Col. 7 - Col. 8 - Col. 9.
Col. 11 = 24 hours of calendar day shown.

Col. 12=Col. 8 - 1,750 ft^3/s computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning October 1, 1990 = 9,762 (ft^3/d)-d.

Table 16. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J. - continued
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants			Daily	Cumul.
Date	Amount				Date			Date	Directed	Other					
1991	1	2	3	4		5	6		7	8	9	10	11	12	13
Feb. 26	0	51	32	25	Feb. 28	813	326	Mar. 1	0	108	1,139	4,183	5,430	0	9,564
27	0	51	32	25	Mar. 1	828	330	2	0	108	1,158	3,984	5,250	0	9,564
28	0	51	32	25	2	0	624	3	0	108	624	6,098	6,830	0	9,564
Mar. 1	0	51	32	25	3	0	663	4	0	108	663	14,929	15,700	0	9,564
2	0	51	32	25	4	747	809	5	0	108	1,556	19,536	21,200	0	9,564
3	0	51	32	25	5	690	720	6	0	108	1,410	13,982	15,500	0	9,564
4	0	51	32	25	6	701	709	7	0	108	1,410	11,882	13,400	0	9,564
5	0	51	32	25	7	724	702	8	0	108	1,426	11,466	13,000	0	9,564
6	0	50	32	25	8	710	628	9	0	107	1,338	8,955	10,400	0	9,564
7	0	50	32	25	9	0	525	10	0	107	525	7,988	8,620	0	9,564
8	0	50	32	25	10	0	596	11	0	107	596	7,047	7,750	0	9,564
9	0	50	32	25	11	692	680	12	0	107	1,372	5,801	7,280	0	9,564
10	0	50	32	25	12	698	330	13	0	107	1,028	5,335	6,470	0	9,564
11	0	50	32	25	13	698	372	14	0	107	1,070	5,083	6,260	0	9,564
12	0	50	59	25	14	659	333	15	0	134	992	5,064	6,190		
13	0	50	32	25	15	702	145	16	0	107	847	4,646	5,600		
14	0	50	32	25	16	0	32	17	0	107	32	4,801	4,940		
15	0	50	32	25	17	0	305	18	0	107	305	5,088	5,500		
16	0	50	32	25	18	811	699	19	0	107	1,510	6,073	7,690		
17	0	50	32	25	19	956	660	20	0	107	1,616	6,367	8,090		
18	0	50	32	25	20	948	688	21	0	107	1,636	5,847	7,590		
19	0	50	32	25	21	923	422	22	0	107	1,345	5,298	6,750		
20	0	48	32	25	22	834	439	23	0	105	1,273	5,482	6,860		
21	0	48	40	25	23	460	681	24	0	113	1,141	7,146	8,400		
22	0	50	32	25	24	527	316	25	0	107	843	8,950	9,900		
23	0	50	32	25	25	947	673	26	0	107	1,620	8,473	10,200		
24	0	50	32	25	26	820	330	27	0	107	1,150	7,613	8,870		
25	0	50	32	25	27	701	354	28	0	107	1,055	7,878	9,040		
26	0	50	32	25	28	692	372	29	0	107	1,064	7,729	8,900		
27	0	50	32	25	29	0	507	30	0	107	507	7,526	8,140		
28	0	50	32	25	30	0	496	31	0	107	496	6,907	7,510		
Total	0	1,554	1,027	775		17,281	15,466		0	3,356	32,747	237,157	273,260		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.

Col. 7= Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.
Col. 10 = Col. 11 - Col. 7 - Col. 8 - Col. 9.
Col. 11 = 24 hours of calendar day shown.

Col. 12 = Col. 8 - 1,750 ft^3/s computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning October 1, 1990 to March 14, 1991 = 9,762 (ft^3/d)-d.

Table 16. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J. - continued
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
									Controlled releases			Computed		Excess Release Credits	
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		N.Y.C. reservoirs		Power-plants	uncon-trolled	Total	Daily	Cumul.
Date	Amount				Date			Date	Directed	Other					
1991	1	2	3	4		5	6		7	8	9	10	11	12	13
Mar. 29	0	50	32	25	Mar. 31	0	301	Apr. 1	0	107	301	6,382	6,790		
30	0	50	32	31	Apr. 1	226	358	2	0	113	584	6,133	6,830		
31	0	53	40	45	2	227	454	3	0	138	681	5,631	6,450		
Apr. 1	0	70	45	45	3	0	393	4	0	160	393	5,497	6,050		
2	0	70	45	45	4	230	127	5	0	160	357	5,163	5,680		
3	0	70	45	45	5	228	99	6	0	160	327	4,533	5,020		
4	0	70	45	46	6	0	75	7	0	161	75	4,564	4,800		
5	0	70	45	43	7	0	149	8	0	158	149	4,693	5,000		
6	0	67	43	45	8	228	177	9	0	155	405	4,100	4,660		
7	0	70	45	46	9	483	0	10	0	161	483	4,696	5,340		
8	0	70	45	46	10	0	0	11	0	161	0	4,789	4,950		
9	0	70	45	46	11	0	174	12	0	161	174	4,675	5,010		
10	0	70	45	48	12	305	0	13	0	163	305	4,162	4,630		
11	0	70	45	48	13	0	0	14	0	163	0	4,057	4,220		
12	0	70	45	46	14	0	223	15	0	161	223	4,176	4,560		
13	0	70	45	43	15	224	465	16	0	158	689	4,283	5,130		
14	0	70	45	45	16	221	114	17	0	160	335	4,115	4,610		
15	0	70	45	45	17	192	131	18	0	160	323	3,747	4,230		
16	0	70	45	45	18	224	117	19	0	160	341	3,259	3,760		
17	0	70	45	45	19	228	177	20	0	160	405	2,885	3,450		
18	0	70	45	45	20	0	106	21	0	160	106	3,504	3,770		
19	0	70	45	45	21	0	504	22	0	160	504	9,226	9,890		
20	0	70	45	46	22	0	663	23	0	161	663	10,976	11,800		
21	0	70	45	46	23	0	667	24	0	161	667	9,572	10,400		
22	0	70	45	46	24	0	691	25	0	161	691	9,008	9,860		
23	0	70	45	46	25	0	426	26	0	161	426	8,353	8,940		
24	0	70	45	46	26	0	67	27	0	161	67	7,252	7,480		
25	0	71	45	46	27	0	0	28	0	162	0	6,398	6,560		
26	0	71	45	46	28	0	266	29	0	162	266	5,642	6,070		
27	0	71	45	46	29	0	351	30	0	162	351	5,097	5,610		
Total	0	2,043	1,317	1,331		3,016	7,275		0	4,691	10,291	166,568	181,550		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.

Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.
Col. 10 = Col. 11 - Col. 7 - Col. 8 - Col. 9.
Col. 11 = 24 hours of calendar day shown.

Table 16. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J. - continued
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount				Date			Date	Directed	Other				Daily	Cumul.
1991	1	2	3	4		5	6		7	8	9	10	11	12	13
Apr. 28	0	67	45	46	Apr. 30	0	355	May 1	0	158	355	4,917	5,430		
29	0	76	45	46	May 1	0	408	2	0	167	408	4,695	5,270		
30	0	67	45	46	2	0	433	3	0	158	433	4,619	5,210		
May 1	0	67	45	46	3	0	248	4	0	158	248	4,224	4,630		
2	0	67	45	46	4	0	142	5	0	158	142	3,680	3,980		
3	0	67	45	46	5	940	0	6	0	158	940	3,772	4,870		
4	0	67	45	46	6	933	110	7	0	158	1,043	5,429	6,630		
5	0	67	45	46	7	0	305	8	0	158	305	6,207	6,670		
6	0	67	45	46	8	0	450	9	0	158	450	5,112	5,720		
7	0	67	45	46	9	0	397	10	0	158	397	4,575	5,130		
8	0	68	45	46	10	0	281	11	0	159	281	4,360	4,800		
9	0	68	45	46	11	0	500	12	0	159	500	3,741	4,400		
10	0	68	45	46	12	0	411	13	0	159	411	3,680	4,250		
11	0	68	45	46	13	525	508	14	0	159	1,033	3,358	4,550		
12	0	68	45	46	14	0	557	15	0	159	557	3,074	3,790		
13	0	70	43	46	15	0	411	16	0	159	411	2,760	3,330		
14	0	71	45	48	16	0	578	17	0	164	578	2,458	3,200		
15	0	68	45	48	17	0	294	18	0	161	294	2,225	2,680		
16	0	68	45	48	18	0	0	19	0	161	0	2,219	2,380		
17	0	68	45	48	19	0	0	20	0	161	0	2,069	2,230		
18	0	70	45	48	20	0	85	21	0	163	85	1,812	2,060		
19	0	68	45	45	21	0	287	22	0	158	287	1,665	2,110		
20	0	68	45	46	22	0	177	23	0	159	177	1,524	1,860		
21	407	68	263	46	23	0	0	24	377	0	0	1,373	1,750		
22	480	68	368	46	24	0	0	25	482	0	0	1,338	1,820		
23	520	70	373	70	25	0	0	26	513	0	0	1,197	1,710		
24	520	102	377	71	26	0	0	27	525	25	0	1,180	1,730		
25	576	99	410	71	27	0	504	28	577	3	504	1,166	2,250		
26	604	104	628	71	28	253	330	29	604	199	583	1,254	2,640		
27	333	99	504	71	29	0	528	30	333	341	528	998	2,200		
28	287	99	439	71	30	552	465	31	288	321	1,017	1,714	3,340		
Total	3,727	2,279	4,395	1,584		3,203	8,764		3,699	4,559	11,967	92,395	112,620		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.

Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.
Col. 10 = Col. 11 - Col. 7 - Col. 8 - Col. 9.
Col. 11 = 24 hours of calendar day shown.

Table 16. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J. - continued
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
									Controlled releases			Computed		Excess Release Credits	
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		N.Y.C. reservoirs		Power-plants	uncon-trolled	Total		
Date	Amount				Date			Date	Directed	Other				Daily	Cumul.
1991	1	2	3	4		5	6		7	8	9	10	11	12	13
May 29	546	99	424	67	May 31	263	138	June 1	547	43	401	2,839	3,830		
30	397	97	433	46	June 1	0	0	2	397	179	0	2,004	2,580		
31	0	70	374	46	2	0	142	3	0	490	142	1,608	2,240		
June 1	0	70	374	46	3	0	173	4	0	490	173	1,397	2,060		
2	334	70	374	46	4	0	25	5	335	155	25	1,315	1,830		
3	569	70	455	46	5	0	0	6	571	0	0	1,229	1,800		
4	367	70	252	46	6	0	0	7	368	0	0	1,242	1,610		
5	451	70	343	45	7	0	0	8	458	0	0	922	1,380		
6	760	70	651	45	8	0	0	9	766	0	0	814	1,580		
7	864	70	755	45	9	0	121	10	870	0	121	769	1,760		
8	784	68	647	71	10	0	535	11	786	0	535	669	1,990		
9	888	99	726	71	11	0	230	12	896	0	230	774	1,900		
10	1,066	99	897	71	12	0	117	13	1,067	0	117	956	2,140		
11	1,054	99	908	43	13	0	39	14	1,050	0	39	1,021	2,110		
12	1,111	67	998	43	14	0	103	15	1,108	0	103	809	2,020	270	270
13	1,027	67	913	45	15	0	312	16	1,025	0	312	743	2,080	330	330
14	1,000	68	860	70	16	0	255	17	998	0	255	617	1,870	120	720
15	857	101	696	70	17	0	223	18	867	0	223	640	1,730	-20	700
16	1,013	101	842	70	18	0	89	19	1,013	0	89	718	1,820	70	770
17	968	101	803	70	19	0	78	20	974	0	78	698	1,750	0	770
18	1,004	101	840	71	20	0	220	21	1,012	0	220	618	1,850	100	870
19	1,215	101	1,055	71	21	0	156	22	1,227	0	156	617	2,000	250	1,120
20	1,207	101	1,036	71	22	0	0	23	1,208	0	0	712	1,920	170	1,290
21	1,266	101	1,097	71	23	0	0	24	1,269	0	0	611	1,880	130	1,420
22	1,126	101	956	71	24	0	0	25	1,128	0	0	572	1,700	-50	1,370
23	1,108	101	967	45	25	0	21	26	1,113	0	21	536	1,670	-80	1,290
24	1,094	71	982	45	26	0	142	27	1,098	0	142	450	1,690	-60	1,230
25	1,048	71	913	71	27	0	160	28	1,055	0	160	475	1,690	-60	1,170
26	1,302	99	1,111	91	28	0	333	29	1,301	0	333	426	2,060	310	1,480
27	1,422	121	1,213	91	29	0	53	30	1,425	0	53	342	1,820	70	1,550
Total	25,848	2,594	22,895	1,800		263	3,665		25,932	1,357	3,928	27,143	58,360		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.

Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.
Col. 10 = Col. 11 - Col. 7 - Col. 8 - Col. 9.
Col. 11 = 24 hours of calendar day shown.

Col. 12 = Col. 8 - 1,750 ft^3/s computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning

Table 16. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J. - continued
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague						
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled		Excess Release Credits
									N.Y.C. reservoirs		Power-plants			
Date	Amount				Date			Date	Directed	Other			Total	Daily	Cumul.
1991	1	2	3	4		5	6		7	8	9	10	11	12	13
June 28	1,272	130	1,058	85	June 30	0	11	July 1	1,273	0	11	406	1,690	-60	1,490
29	1,184	130	972	87	July 1	126	4	2	1,189	0	130	371	1,690	-60	1,430
30	1,343	130	1,151	65	2	0	195	3	1,346	0	195	399	1,940	190	1,620
July 1	1,503	101	1,360	45	3	0	0	4	1,506	0	0	424	1,930	180	1,800
2	1,403	70	1,293	45	4	0	0	5	1,408	0	0	432	1,840	90	1,890
3	1,469	70	1,332	68	5	0	0	6	1,470	0	0	430	1,900	150	2,040
4	1,418	102	1,253	70	6	0	0	7	1,425	0	0	425	1,850	100	2,140
5	1,283	97	1,109	71	7	0	117	8	1,277	0	117	416	1,810	60	2,200
6	1,137	97	959	85	8	46	216	9	1,141	0	262	357	1,760	10	2,210
7	1,121	128	934	60	9	0	60	10	1,122	0	60	328	1,510	-240	1,970
8	1,253	97	1,109	45	10	0	18	11	1,251	0	18	301	1,570	-180	1,790
9	1,501	70	1,391	45	11	0	7	12	1,506	0	7	317	1,830	80	1,870
10	1,555	70	1,411	71	12	0	0	13	1,552	0	0	198	1,750	0	1,870
11	1,592	97	1,423	71	13	0	113	14	1,591	0	113	236	1,940	190	2,060
12	1,560	97	1,392	71	14	0	117	15	1,560	0	117	303	1,980	230	2,290
13	1,366	97	1,204	71	15	234	174	16	1,372	0	408	290	2,070	320	2,610
14	1,620	97	1,453	71	16	0	297	17	1,621	0	297	182	2,100	350	2,960
15	1,482	97	1,318	71	17	0	262	18	1,486	0	262	142	1,890	140	3,100
16	1,250	97	1,080	71	18	224	361	19	1,248	0	585	197	2,030	280	3,380
17	1,278	130	1,057	91	19	506	0	20	1,278	0	506	426	2,210	460	3,840
18	1,575	130	1,364	91	20	0	0	21	1,585	0	0	255	1,840		
19	1,468	130	1,245	91	21	0	266	22	1,466	0	266	208	1,940		
20	779	128	566	91	22	471	305	23	785	0	776	409	1,970		
21	763	128	552	91	23	474	330	24	771	0	804	385	1,960		
22	717	101	549	70	24	449	174	25	720	0	623	557	1,900		
23	604	79	453	70	25	424	160	26	602	0	584	474	1,660		
24	865	68	760	45	26	475	0	27	873	0	475	452	1,800		
25	1,345	70	1,233	45	27	0	0	28	1,348	0	0	472	1,820		
26	1,079	70	964	45	28	218	4	29	1,079	0	222	369	1,670		
27	810	70	698	45	29	460	10	30	813	0	470	367	1,650		
28	791	70	676	45	30	457	42	31	791	0	499	340	1,630		
Total	38,386	3,048	33,319	2,088		4,564	3,243		38,455	0	7,807	10,868	57,130		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.

Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.
Col. 10 = Col. 11 - Col. 7 - Col. 8 - Col. 9.
Col. 11 = 24 hours of calendar day shown.

Col. 12 = Col. 8 - 1,750 ft^3/s computed algebraically, but not greater than Col. 7; except that part of Col. 8 contributing to the excess-release increment of Col. 11.
Col. 13 - Season limit of cumulative credit beginning June 15, 1991 = 11,418 $(ft^3/d)\cdot d$. Excess-Release quantity suspended July 18, 1991.

Table 16. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J. - continued
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
									Controlled releases					Excess Release Credits	
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		N.Y.C. reservoirs		Power-plants	Computed uncon-trolled	Total		
Date	Amount				Date			Date	Directed	Other				Daily	Cumul.
1991	1	2	3	4		5	6		7	8	9	10	11		
July 29	1,319	70	1,205	45	July 31	30	117	Aug. 1	1,320	0	147	283	1,750		
30	1,389	71	1,278	45	Aug. 1	43	117	2	1,394	0	160	216	1,770		
31	1,402	70	1,258	70	2	0	0	3	1,398	0	0	262	1,660		
Aug. 1	1,425	97	1,235	90	3	0	0	4	1,422	0	0	288	1,710		
2	1,449	128	1,231	90	4	0	0	5	1,449	0	0	341	1,790		
3	1,482	128	1,264	88	5	0	0	6	1,480	0	0	310	1,790		
4	1,393	127	1,196	68	6	0	124	7	1,391	0	124	285	1,800		
5	1,450	97	1,307	45	7	0	135	8	1,449	0	135	176	1,760		
6	1,243	71	1,131	45	8	230	0	9	1,247	0	230	343	1,820		
7	1,451	70	1,338	45	9	0	0	10	1,453	0	0	407	1,860		
8	1,217	70	1,108	45	10	0	0	11	1,223	0	0	597	1,820		
9	1,085	70	972	45	11	0	71	12	1,087	0	71	522	1,680		
10	415	70	303	45	12	574	142	13	418	0	716	576	1,710		
11	461	70	303	91	13	584	96	14	464	0	680	436	1,580		
12	461	70	302	91	14	770	216	15	463	0	986	441	1,890		
13	957	70	842	45	15	411	358	16	957	0	769	284	2,010		
14	844	99	678	68	16	574	358	17	845	0	932	413	2,190		
15	1,398	97	1,242	68	17	0	53	18	1,407	0	53	320	1,780		
16	1,315	97	1,140	68	18	0	277	19	1,305	0	277	528	2,110		
17	1,155	97	989	68	19	60	0	20	1,154	0	60	746	1,960		
18	702	97	540	63	20	0	0	21	700	0	0	790	1,490		
19	512	97	497	43	21	0	32	22	512	125	32	1,001	1,670		
20	319	80	196	43	22	0	142	23	319	0	142	1,939	2,400		
21	0	73	36	43	23	0	0	24	0	152	0	1,338	1,490		
22	576	244	291	43	24	0	0	25	578	0	0	492	1,070		
23	828	308	487	43	25	0	117	26	838	0	117	405	1,360		
24	983	306	631	43	26	0	63	27	980	0	63	607	1,650		
25	1,071	306	727	43	27	0	298	28	1,076	0	298	386	1,760		
26	1,179	306	800	70	28	0	340	29	1,176	0	340	304	1,820		
27	1,224	306	851	70	29	0	248	30	1,227	0	248	345	1,820		
28	1,384	306	1,006	70	30	0	0	31	1,382	0	0	398	1,780		
Total	32,089	4,168	26,384	1,839		3,276	3,304		32,114	277	6,580	15,779	54,750		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.

Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.
Col. 10 = Col. 11 - Col. 7 - Col. 8 - Col. 9.
Col. 11 = 24 hours of calendar day shown.

Table 16. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J. - continued
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled		Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount				Date			Date	Directed	Other			Total	Daily	Cumul
1991	1	2	3	4		5	6		7	8	9	10	11	12	13
Aug. 29	1,400	374	990	43	Aug. 31	0	0	Sept. 1	1,407	0	0	243	1,650		
30	1,400	373	985	43	Sept. 1	0	0	2	1,401	0	0	159	1,560		
31	1,416	373	1,007	43	2	0	0	3	1,423	0	0	187	1,610		
Sept. 1	1,441	371	1,023	43	3	53	0	4	1,437	0	53	160	1,650		
2	1,451	371	1,035	42	4	0	0	5	1,448	0	0	332	1,780		
3	1,464	528	896	43	5	0	0	6	1,467	0	0	263	1,730		
4	1,456	524	891	46	6	0	0	7	1,461	0	0	229	1,690		
5	1,536	523	970	48	7	0	0	8	1,541	0	0	239	1,780		
6	1,537	735	746	71	8	0	0	9	1,552	0	0	168	1,720		
7	1,308	735	520	70	9	173	142	10	1,325	0	315	200	1,840		
8	1,320	733	520	70	10	225	0	11	1,323	0	225	182	1,730		
9	1,286	732	512	45	11	219	0	12	1,289	0	219	182	1,690		
10	1,285	730	511	45	12	224	0	13	1,286	0	224	190	1,700		
11	1,312	729	546	43	13	229	0	14	1,318	0	229	143	1,690		
12	1,512	726	738	43	14	0	0	15	1,507	0	0	143	1,650		
13	1,485	724	716	43	15	0	220	16	1,483	0	220	77	1,780		
14	656	347	260	43	16	967	202	17	650	0	1,169	401	2,220		
15	670	368	260	43	17	873	46	18	671	0	919	330	1,920		
16	635	294	258	85	18	803	11	19	637	0	814	719	2,170		
17	611	277	257	77	19	828	0	20	611	0	828	821	2,260		
18	535	237	257	43	20	808	0	21	537	0	808	1,045	2,390		
19	763	459	257	43	21	0	0	22	759	0	0	731	1,490		
20	885	580	255	43	22	0	0	23	878	0	0	502	1,380		
21	259	178	32	46	23	811	298	24	256	0	1,109	615	1,980		
22	291	213	32	43	24	816	57	25	288	0	873	829	1,990		
23	125	68	32	25	25	823	270	26	125	0	1,093	912	2,130		
24	0	20	23	15	26	802	17	27	0	58	819	883	1,760		
25	213	139	34	43	27	813	0	28	216	0	813	571	1,600		
26	989	692	258	43	28	0	0	29	993	0	0	257	1,250		
27	1,066	707	314	43	29	0	0	30	1,064	0	0	386	1,450		
Total	30,307	13,860	15,135	1,416		9,467	1,263		30,353	58	10,730	12,099	53,240		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.

Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.
Col. 10 = Col. 11 - Col. 7 - Col. 8 - Col. 9.
Col. 11 = 24 hours of calendar day shown.

Table 16. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J. - continued
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants				
Date	Amount				Date			Date	Directed	Other				Daily	Cumul.
1991	1	2	3	4		5	6		7	8	9	10	11		
Sept. 28	525	449	32	43	Sept.30	618	21	Oct. 1	524	0	639	587	1,750		
29	590	511	32	45	Oct. 1	648	0	2	588	0	648	454	1,690		
30	423	347	32	45	2	751	0	3	424	0	751	485	1,660		
Oct. 1	452	371	32	45	3	832	0	4	448	0	832	400	1,680		
2	418	345	34	45	4	802	0	5	424	0	802	404	1,630		
3	1,372	695	695	45	5	0	0	6	1,372	63	0	105	1,540		
4	1,346	687	608	45	6	0	0	7	1,340	0	0	450	1,790		
5	421	339	32	45	7	881	0	8	416	0	881	713	2,010		
6	418	70	308	45	8	783	0	9	423	0	783	534	1,740		
7	350	70	227	45	9	864	0	10	342	0	864	524	1,730		
8	350	139	167	43	10	851	0	11	349	0	851	510	1,710		
9	383	308	34	45	11	829	0	12	387	0	829	654	1,870		
10	1,160	70	1,046	45	12	0	0	13	1,161	0	0	439	1,600		
11	624	70	507	45	13	0	0	14	622	0	0	808	1,430		
12	182	105	32	45	14	283	0	15	182	0	283	965	1,430		
13	482	405	32	43	15	0	32	16	480	0	32	1,418	1,930		
14	0	26	23	15	16	290	35	17	0	64	325	1,791	2,180		
15	0	19	23	15	17	903	163	18	0	57	1,066	2,657	3,780		
16	0	19	23	15	18	833	0	19	0	57	833	2,280	3,170		
17	0	19	23	17	19	712	0	20	0	59	712	1,869	2,640		
18	0	19	23	15	20	789	96	21	0	57	885	1,468	2,410		
19	0	19	23	15	21	57	43	22	0	57	100	1,383	1,540		
20	0	19	23	15	22	0	145	23	0	57	145	1,118	1,320		
21	0	19	23	17	23	0	177	24	0	59	177	1,064	1,300		
22	207	128	32	45	24	0	99	25	205	0	99	836	1,140		
23	325	246	34	45	25	0	0	26	325	0	0	775	1,100		
24	918	619	248	45	26	0	0	27	912	0	0	578	1,490		
25	353	274	32	46	27	0	213	28	352	0	213	825	1,390		
26	226	155	34	45	28	0	234	29	234	0	234	712	1,180		
27	216	139	32	45	29	0	230	30	216	0	230	674	1,120		
28	254	178	32	43	30	0	199	31	253	0	199	588	1,040		
Total	11,995	6,879	4,478	1,152		11,726	1,687		11,979	530	13,413	28,068	53,990		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.

Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.
Col. 10 = Col. 11 - Col. 7 - Col. 8 - Col. 9.
Col. 11 = 24 hours of calendar day shown.

Table 16. - Controlled releases for reservoirs in the upper Delaware River basin and segregation of flow of Delaware River at Montague, N.J. - continued
(River Master daily operation record)
Mean discharge in cubic feet per second for 24 hours

Controlled releases from New York City reservoirs					Controlled releases from power reservoirs			Segregation of flow Delaware River at Montague							
Directed		Pepacton	Cannonsville	Neversink		Lake Wallen-paupack	Rio Reservoir		Controlled releases			Computed uncon-trolled	Total	Excess Release Credits	
									N.Y.C. reservoirs		Power-plants			Daily	Cumul.
Date	Amount				Date			Date	Directed	Other					
1992	1	2	3	4		5	6		7	8	9	10	11	12	13
Oct. 29	466	71	348	46	Oct. 31	0	14	Nov. 1	465	0	14	1,421	1,900	150	9,338
30	376	71	260	46	Nov. 1	0	14	2	377	0	14	1,459	1,850	100	9,438
31	0	71	39	40	2	466	234	3	0	150	700	2,230	3,080	0	9,438
Nov. 1	0	68	36	25	3	712	269	4	0	129	981	5,450	6,560	0	9,438
2	0	48	32	25	4	464	305	5	0	105	769	4,436	5,310	0	9,438
3	0	48	32	25	5	507	252	6	0	105	759	4,206	5,070	0	9,438
4	0	48	32	25	6	706	202	7	0	105	908	3,847	4,860	0	9,438
5	0	48	34	25	7	0	0	8	0	107	0	3,573	3,680	0	9,438
6	0	48	34	25	8	114	181	9	0	107	295	3,168	3,570	0	9,438
7	0	48	34	25	9	95	159	10	0	107	254	2,909	3,270	0	9,438
8	0	48	34	23	10	0	160	11	0	105	160	2,615	2,880	0	9,438
9	0	48	32	23	11	0	85	12	0	103	85	2,772	2,960	0	9,438
10	0	48	32	23	12	0	74	13	0	103	74	4,223	4,400	0	9,438
11	0	48	32	25	13	0	0	14	0	105	0	8,255	8,360	0	9,438
12	0	48	32	25	14	0	0	15	0	105	0	6,415	6,520	0	9,438
13	0	48	32	25	15	0	252	16	0	105	252	5,143	5,500	0	9,438
14	0	48	32	25	16	208	387	17	0	105	595	4,340	5,040	0	9,438
15	0	50	32	25	17	12	312	18	0	107	324	3,959	4,390	0	9,438
16	0	50	32	25	18	0	202	19	0	107	202	3,771	4,080	0	9,438
17	0	50	32	25	19	173	397	20	0	107	570	3,233	3,910	0	9,438
18	0	50	32	25	20	0	330	21	0	107	330	2,943	3,380	0	9,438
19	0	50	32	25	21	0	46	22	0	107	46	3,247	3,400	0	9,438
20	0	50	32	25	22	0	262	23	0	107	262	7,501	7,870	0	9,438
21	0	50	32	25	23	0	500	24	0	107	500	11,593	12,200	0	9,438
22	0	50	34	25	24	0	688	25	0	109	688	9,503	10,300	0	9,438
23	0	50	34	26	25	0	798	26	0	110	798	8,992	9,900	0	9,438
24	0	50	34	26	26	0	618	27	0	110	618	8,702	9,430	0	9,438
25	0	50	34	26	27	0	696	28	0	110	696	7,904	8,710	0	9,438
26	0	50	34	26	28	0	528	29	0	110	528	6,532	7,170	0	9,438
27	0	50	34	26	29	0	425	30	0	111	425	5,654	6,190	0	9,438
Total	842	1,556	1,535	806		3,457	8,390		842	3,055	11,847	149,996	165,740		

Col. 2 - 24 hours beginning 1200 of date shown.
Col. 3 - 24 hours ending 2400 one day later.
Col. 4 - 24 hours beginning 1500 one day later.
Col. 5 - 24 hours beginning 0800 of date shown.
Col. 6 - 24 hours beginning 1600 of date shown.

Col. 7 = Col. 2 + Col. 3 + Col. 4 in response to Col. 1.
Col. 8 = Col. 2 + Col. 3 + Col. 4 - Col. 7.
Col. 9 = Col. 5 + Col. 6.
Col. 10 = Col. 11 - Col. 7 - Col. 8 - Col. 9.
Col. 11 = 24 hours of calendar day shown.

Table 17. - Consumption of Water by New York City - 1950 to 1991.
Data furnished by New York City, Department of
Environmental Protection, Bureau of Water Supply

Year	Average daily consumption			Annual consumption (bg)
	City proper (Mgal/d)	Outside communities (Mgal/d)	Total (Mgal/d)	
1950	953.3	29.1	982.4	358.576
51	1,041.9	28.1	1,070.0	390.550
52	1,087.0	32.7	1,119.7	409.810
53	1,093.9	44.6	1,138.5	415.552
54	1,063.4	46.3	1,109.7	405.040
1955	1,109.9	45.3	1,155.2	421.648
56	1,111.3	48.9	1,160.2	424.633
57	1,169.0	57.2	1,226.2	447.563
58	1,152.9	49.6	1,202.5	438.912
59	1,204.3	60.3	1,264.6	461.579
1960	1,199.4	58.9	1,258.3	460.529
61	1,221.0	64.0	1,285.0	469.022
62	1,207.6	68.8	1,276.4	465.896
63	1,218.0	76.7	1,294.7	472.582
64	1,189.2	79.4	1,268.6	464.295
1965	1,052.1	71.2	1,123.3	409.995
66	1,044.9	73.2	1,118.1	408.128
67	1,135.3	71.0	1,206.3	440.302
68	1,242.0	78.2	1,320.2	483.175
69	1,328.7	80.1	1,408.8	514.229
1970	1,400.3	90.4	1,490.7	544.116
71	1,423.6	87.9	1,511.5	551.695
72	1,412.4	83.0	1,495.4	547.340
73	1,448.9	95.4	1,544.3	563.681
74	1,441.8	96.3	1,538.1	561.409
1975	1,415.0	92.1	1,507.1	550.093
76	1,435.0	95.8	1,530.8	560.264
77	1,483.0	104.7	1,587.7	579.510
78	1,479.4	103.0	1,582.4	577.566
79	1,513.0	104.6	1,617.6	590.426
1980	1,506.3	110.1	1,616.3	591.582
81	1,309.5	100.0	1,409.5	514.475
82	1,383.0	104.8	1,487.8	543.060
83	1,424.2	112.6	1,536.8	561.010
84	1,465.2	113.9	1,579.1	577.963
1985	1,325.4	106.5	1,431.9	522.656
86	1,351.1	115.2	1,466.3	535.200
87	1,447.1	119.8	1,566.9	571.885
88	1,484.3	125.6	1,609.9	589.090
89	1,402.0	113.4	1,515.4	553.158
1990	1,424.4	122.4	1,546.8	564.577
91	1,469.9	123.6	1,593.5	581.628

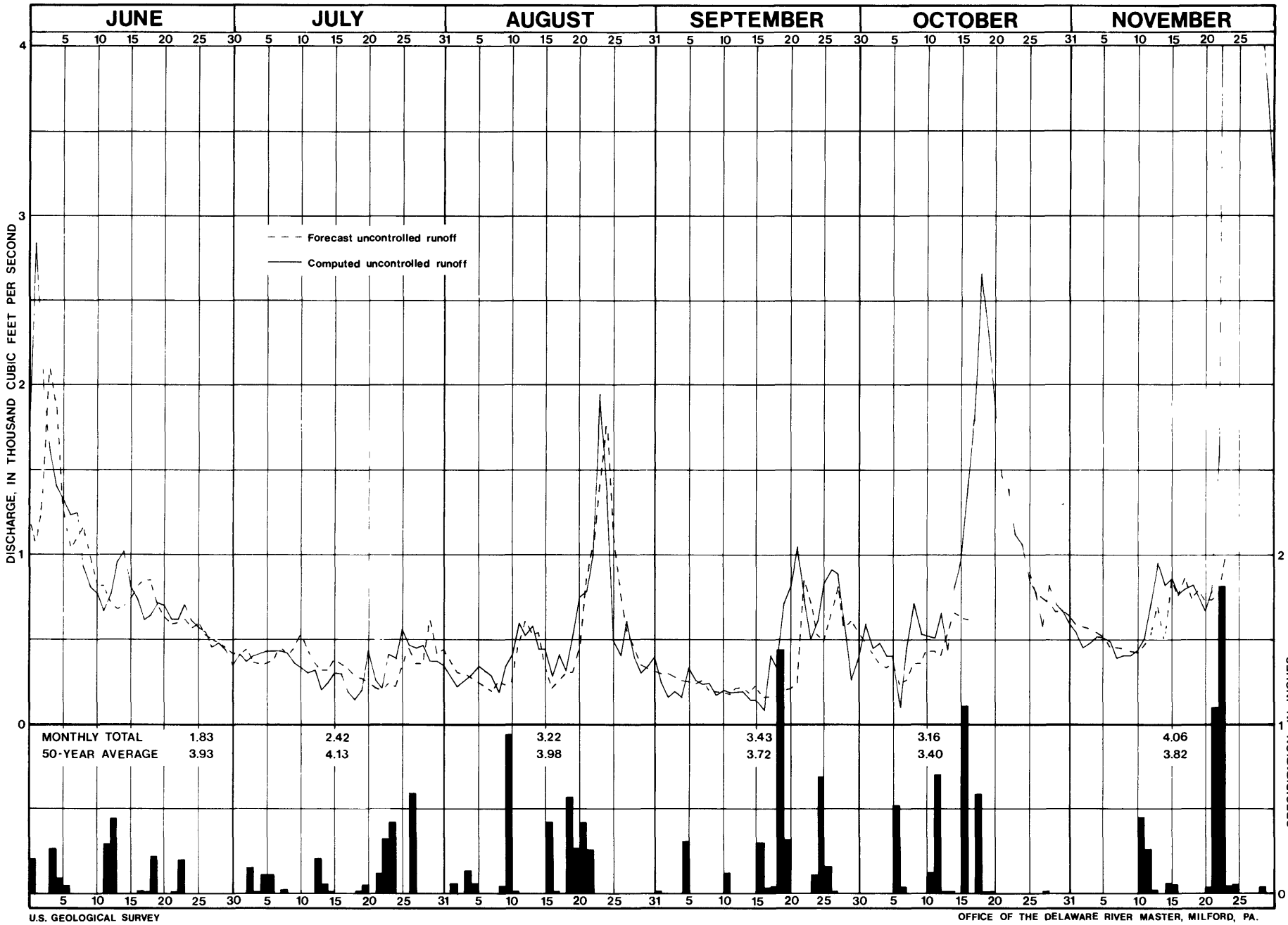

Figure 3.- Uncontrolled runoff component, Delaware River at Montague, N.J., June 1 to November 30,1991.

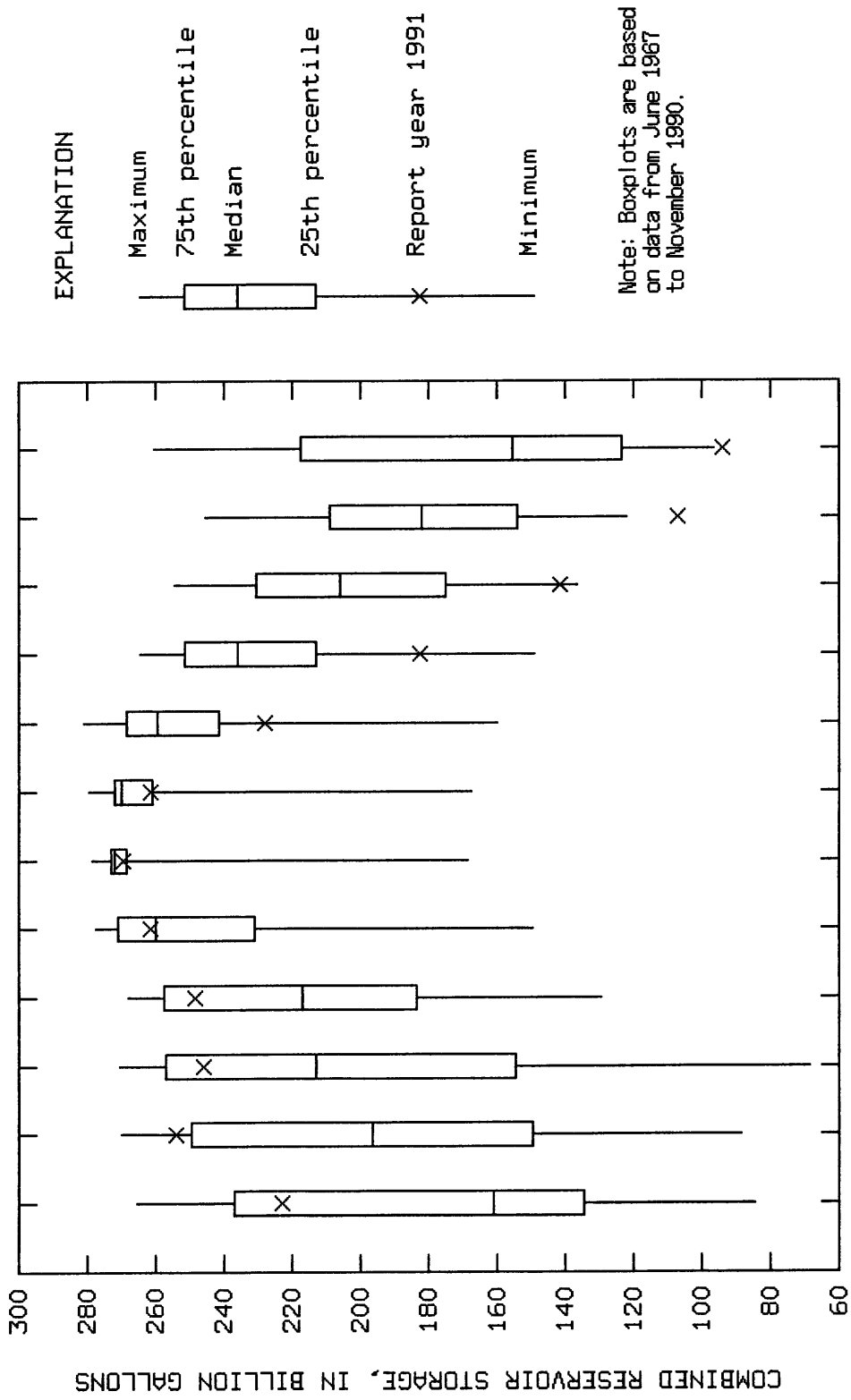

Figure 4.- Combined storage in Pepacton, Cannonsville, and Neversink Reservoirs on the first day of the month, December 1990 to November 1991, compared to June 1967 to November 1990.

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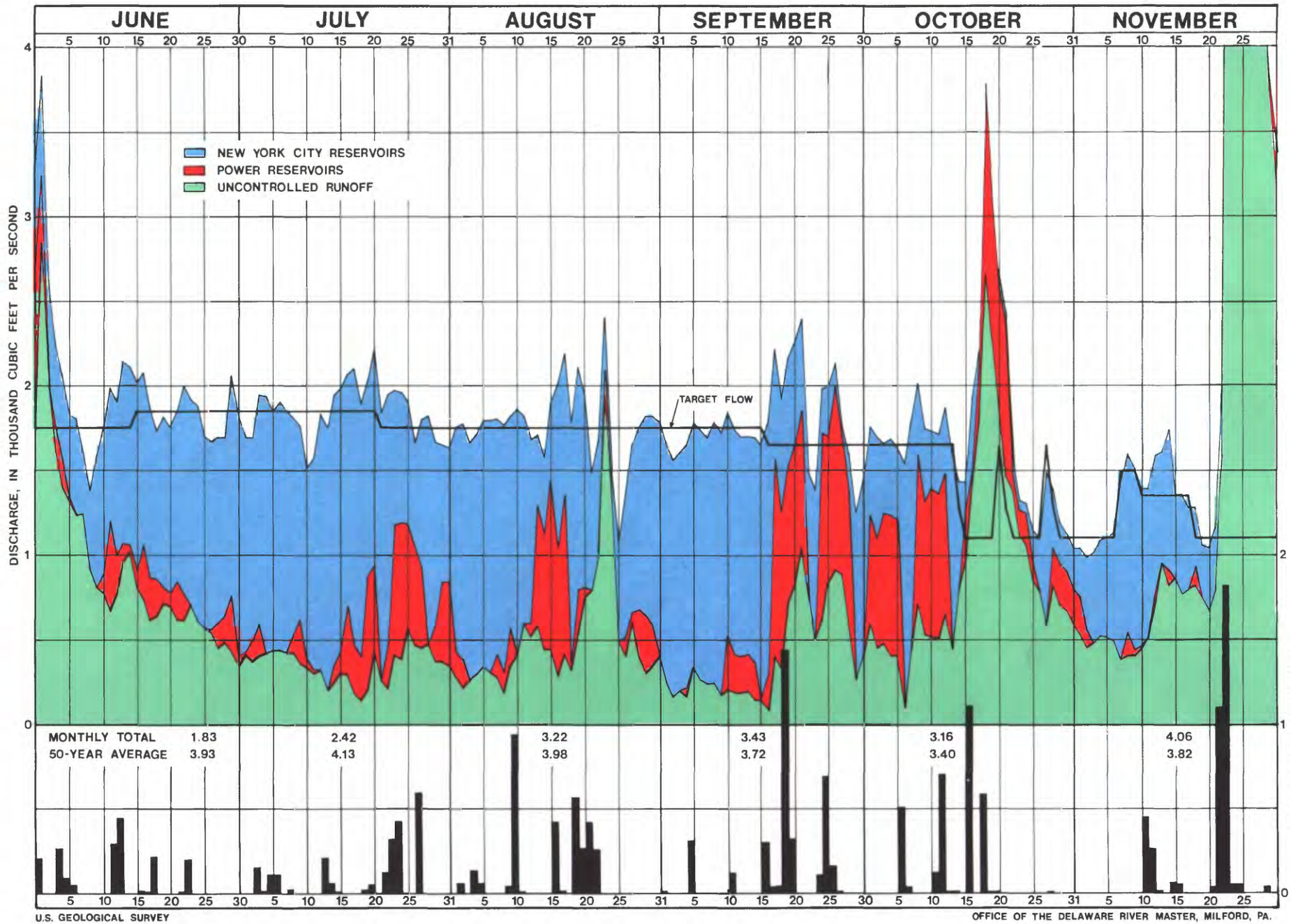

Plate 1. - Components of flow, Delaware River at Montague, N.J., June 1 to November 30, 1991.

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Section III

WATER QUALITY OF THE DELAWARE RIVER ESTUARY

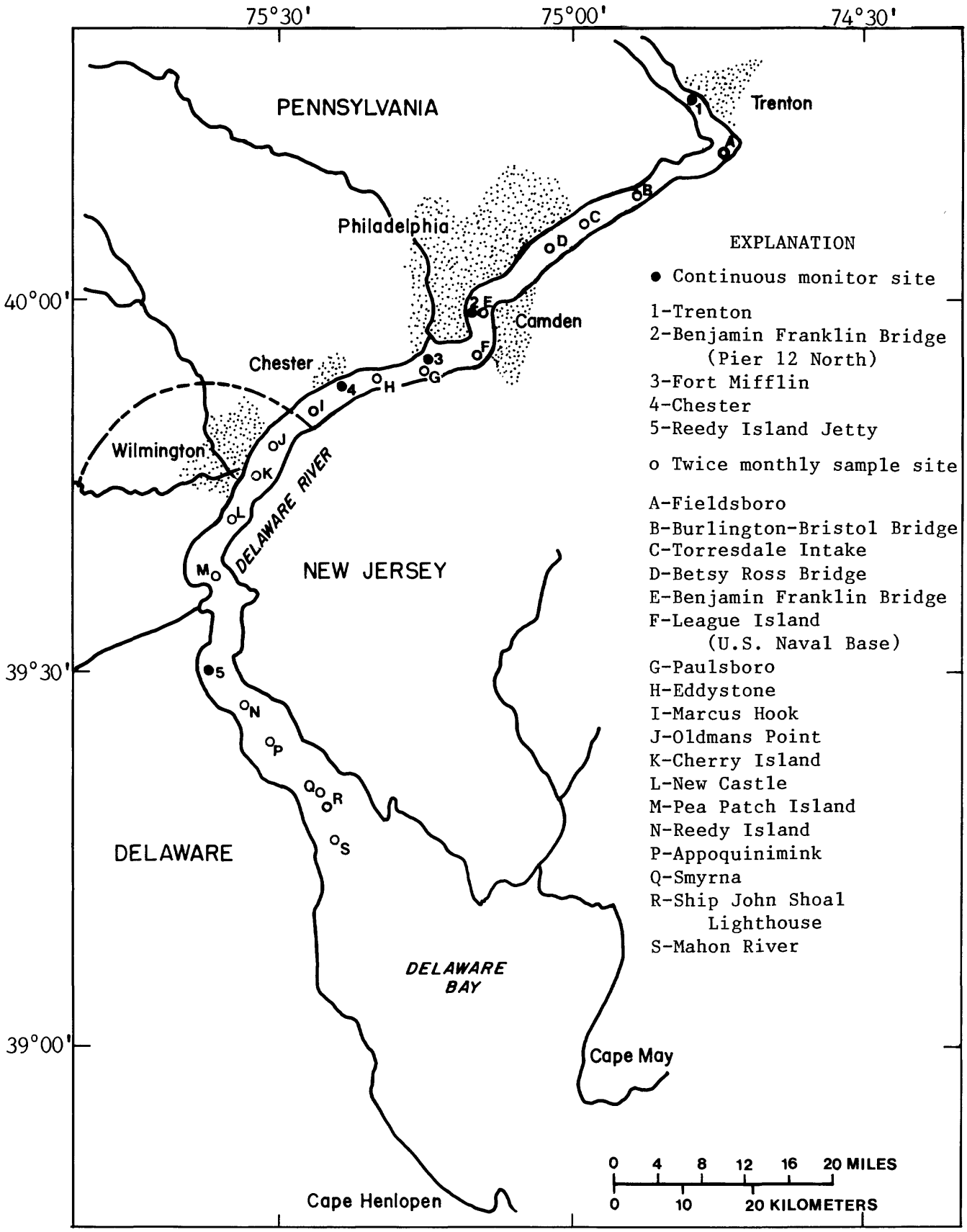

Figure 5.- Delaware River Estuary

Section III

WATER QUALITY OF THE DELAWARE RIVER ESTUARY

by Kirk E. White

INTRODUCTION

This section describes the water-quality monitoring program conducted by the U.S. Geological Survey in the Delaware River Estuary during the 1991 report year. Also presented here are some of the data that were obtained by this program and a brief discussion of the significance of the data.

WATER-QUALITY MONITORING PROGRAM

Water quality of the Delaware River and Estuary was monitored between Trenton, N.J., and Reedy Island Jetty, Del. Data were acquired continuously by electronic instruments at five monitor sites, one at Trenton just upstream of the head of tidewater and four in the estuary (fig. 5). The monitors at Chester, Pa., Fort Mifflin, Pa., and Benjamin Franklin Bridge were not operated from December 1, 1990 through March 4, 1991. At Fort Mifflin the water was monitored for two parameters: temperature and specific conductance. At the remaining sites, the water was monitored for four parameters: temperature, specific conductance, dissolved oxygen, and pH.

Additional data were obtained twice a month from March to November at 18 sites between Fieldsboro, N.J., and the mouth of the Mahon River (fig. 5). At each of these sites, samples of water were collected at the center of the river channel. These samples were analyzed for 28 parameters including temperature, chloride, alkalinity, specific conductance, dissolved oxygen, and pH.

Data obtained from the continuous monitoring sites were processed by computer and stored for future reference by the U.S. Geological Survey. They were also distributed regularly to cooperators and published annually by the U.S. Geological Survey in "Water Resources Data for Pennsylvania, Volume 1, Delaware River Basin." Data from the twice a month sites were collected by the State of Delaware for the Delaware River Basin Commission (DRBC) at 18 sites. These data are available from the DRBC and from STORET, the U.S. Environmental Protection Agency's data storage system.

The above-described programs were carried out in cooperation with the Delaware River Basin Commission, Delaware River Master, and other agencies of federal, state, and county governments.

ESTAURINE WATER-QUALITY DATA DURING 1991

The following is a summary and discussion of the data that were collected during the 1991 report year.

Streamflow

Streamflow is a vital factor which influences the water quality of the estuary. Increased streamflow usually results in better water quality by limiting salt-water intrusion and diluting the concentration of dissolved minerals, both of which contribute to a lower specific conductance and chloride level. Increased flow also aids in maintaining lower water temperature during warm weather and supporting dissolved-oxygen levels.

On the basis of streamflow records for the Delaware River at Trenton, monthly mean streamflow was lowest for the year during August (3,178 ft^3/s) and highest for the year during December (21,100 ft^3/s) (table 9). The monthly mean streamflow was above the respective mean monthly for the period of record in December, January, and February, and below the mean monthly for the remainder of the year.

Temperature

The significance of water temperature in regard to water quality in the estuary lies in its profound influence on various physical, chemical, and biological properties of the water. In general, increases in water temperature have deleterious effects on water quality by lowering the saturation level of dissolved oxygen and increasing biological activities. The primary factors involved in controlling water temperature in the estuary are climatic; however, various uses of the water by man can also have significant effects.

Based on records from Benjamin Franklin Bridge (Pier 12 North), Philadelphia, Pa., monthly mean temperatures for the period March to November 1991 were below normal during August and equaled or exceeded the norm during the rest of the year. The norm is based on historical temperature records from 1962 to 1990 (fig. 6).

Specific Conductance and Chloride

Specific conductance is the ability of a solution to conduct electricity. It can be used as an indicator of the amount of ionized material in solution and relates approximately to dissolved-solids content.

Specific conductance values in bodies of water usually reflect the geochemistry of the drainage basin; however, pollution and the intrusion of oceanic salts can also have a considerable effect on specific conductance. Increasing streamflows reduce the concentration of dissolved solids, thus lowering specific conductance and chloride levels. Conversely, decreasing flows have the opposite effects.

In the Delaware Estuary, the intrusion of oceanic salts is important to those who must use the estuary as a water supply. For this reason, chloride concentration is of great interest. Water with chloride concentrations in excess of 250 mg/L(milligrams per liter) is usually considered undesirable for domestic use, and water with concentrations in excess of 50 mg/L is unsatisfactory for some industrial uses.

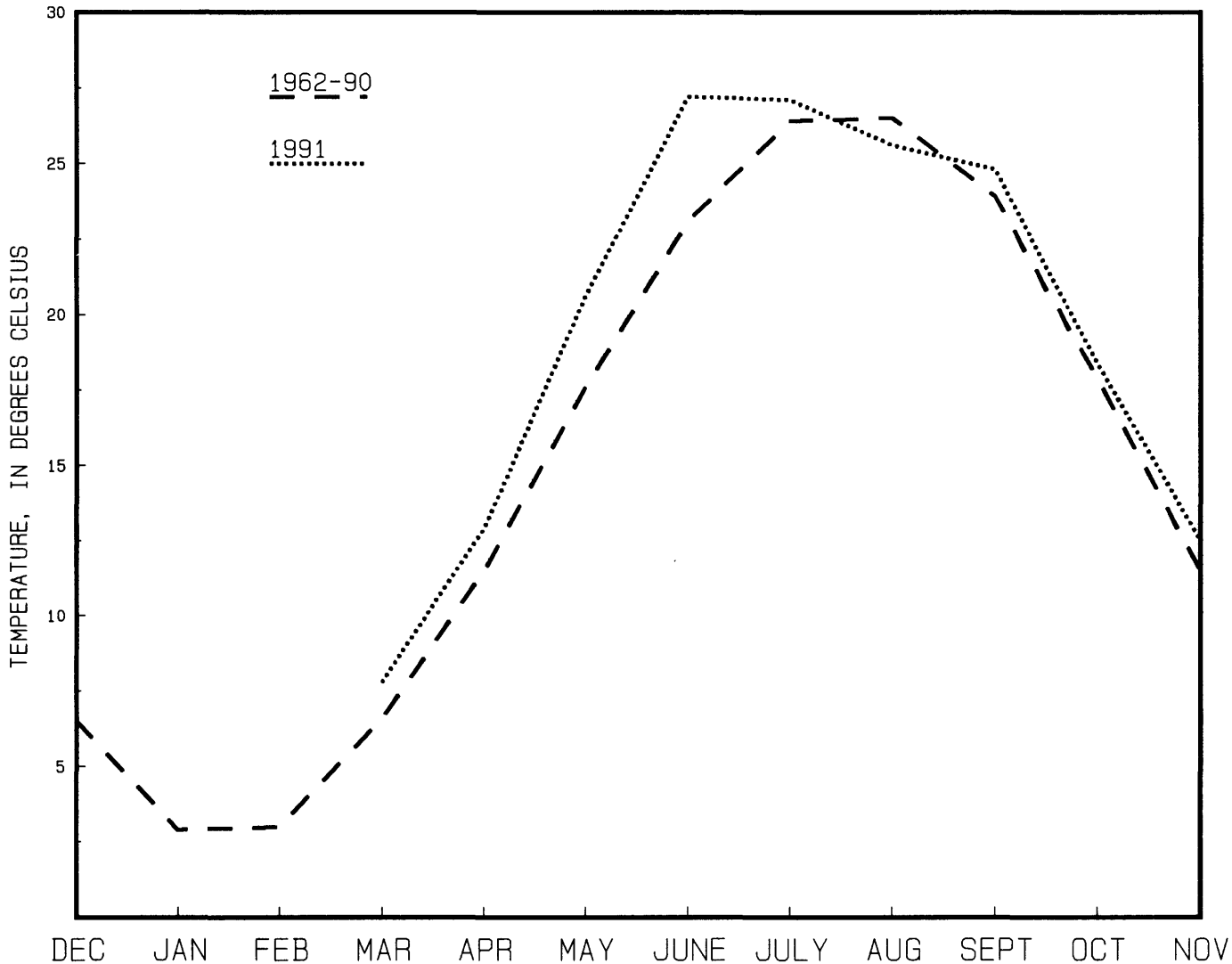

Figure 6.- Monthly mean temperatures of the Delaware River at Benjamin Franklin Bridge, Philadelphia, Pennsylvania.

As sea water has a chloride concentration of approximately 19,000 mg/L, the location of a body of water in relation to the sea can influence chloride levels in that body of water. For this reason, chloride concentrations in the Delaware Estuary generally increase with distance downstream toward the Delaware Bay and Atlantic Ocean.

Chloride concentration was not measured directly at Fort Mifflin, Pa., and Reedy Island Jetty, Del., but a correlation between specific conductance and chloride concentrations has been developed based on analyses of water samples taken in the estuary. Chloride concentrations estimated from that correlation are presented in tables 18 and 20. The correlation is less reliable when chloride concentrations are lower than 30mg/L because other ionized materials may be present in amounts large enough to affect the conductance-chloride correlation. Therefore, chloride concentrations derived from specific conductance are not given when chloride concentrations of less than 30 mg/L are indicated. Chloride concentrations at Chester, Pa., (table 19) were furnished by Scott Paper Company.

At Fort Mifflin, the maximum daily chloride concentration equaled or exceeded 50 mg/L 22 percent of the time (table 18). The maximum was 230 mg/L on November 22. At Chester, the minimum daily chloride concentration equaled or exceeded 50 mg/L, 41 percent of the time and the maximum daily concentration was greater than 50 mg/L, 49 percent of the time (table 19). The maximum daily chloride concentration was 1,080 mg/L on November 22. Minimum chloride concentrations at Reedy Island Jetty were below 250 mg/L on December 9-11, December 23, February 1-6, and March 7-9 (table 20). Except for a period of high chloride concentrations in October and November, maximum chloride concentrations typically ranged from 2,000 to 7,000 mg/L. The maximum at this site was 12,000 mg/L on November 11.

Dissolved Oxygen

Dissolved oxygen is necessary in water for the respiration of aquatic organisms. It also plays a significant role in chemical reactions in aquatic environments. The major sources of dissolved oxygen in water are diffusion from the atmosphere and photosynthesis in aquatic plants. Dissolved-oxygen concentrations are limited by temperature, salinity, and the partial pressure of atmospheric oxygen.

Dissolved-oxygen levels in the estuary tend to be highest near Trenton and to decrease with distance downstream to a point near or somewhat downstream from the Benjamin Franklin Bridge, where minimum values are usually reached. During the past year, daily mean dissolved-oxygen concentration at the Benjamin Franklin Bridge was below 5 mg/L from May 30 through June 7, June 12 through September 2, and September 6-29 (table 21). The minimum daily mean was 2.5 mg/L on July 31 and August 1. At Chester, the daily mean dissolved-oxygen concentration was below 5 mg/L on July 15-16 and July 28 (table 22). The lowest daily mean was 4.7 mg/L on July 15. The minimum hourly value was 4.3 mg/L on June 22, July 15, and August 22. At Reedy Island Jetty, the minimum hourly value was 4.1 on August 12.

Table 18. - Daily maximum and minimum chloride concentrations, Delaware River at Fort Mifflin, Pa., in milligrams per liter
December 1, 1990 to November 30, 1991.
{Monitor was not in operation December 1, 1990 to March 4, 1991; a dash (-) indicates missing data;
*indicates less than 30 mg/L (milligrams per liter); max is maximum value; min is minimum value}

Day	December		January		February		March		April		May		June		July		August		September		October		November	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1									*	*	-	-	*	*	35	30	36	30	36	30	44	37	68	41
2									*	*	-	-	*	*	33	30	35	31	37	30	43	38	66	43
3									*	*	-	-	*	*	38	31	37	32	35	31	44	37	57	42
4									*	*	*	*	*	*	38	31	37	33	36	30	44	38	60	43
5							-	-	*	*	*	*	*	*	40	32	40	32	35	31	46	39	56	44
6							-	-	*	*	33	*	*	*	40	32	44	33	37	32	46	39	72	46
7							-	-	*	*	33	*	*	*	49	33	43	33	38	33	45	38	80	46
8							-	-	30	*	*	*	*	*	49	35	43	35	41	33	46	39	76	51
9							-	-	*	*	31	*	*	*	48	35	82	33	40	34	48	39	94	53
10							-	-	*	*	*	*	*	*	56	35	68	33	42	35	46	38	150	59
11								-	*	*	*	*	35	*	53	36	38	30	44	37	49	40	150	71
12							-	-	*	*	30	*	39	*	44	35	38	*	46	37	51	41	93	62
13							-	-	*	*	32	*	48	*	79	35	35	31	46	38	51	40	100	62
14							-	-	33	*	33	*	38	*	42	*	36	30	46	39	53	42	92	64
15							-	-	35	*	30	*	35	*	34	*	36	31	53	38	51	43	96	60
16							-	-	38	*	31	*	33	*	32	*	38	33	51	40	56	42	92	67
17							-	-	36	*	*	*	36	*	31	*	37	33	49	40	58	44	110	64
18							-	-	30	*	*	*	43	*	30	*	36	32	53	41	65	42	130	64
19							-	-	*	*	*	*	57	*	30	*	44	31	55	42	48	40	130	68
20							-	-	30	*	*	*	42	*	30	*	63	34	56	42	46	37	150	67
21							-	-	80	*	*	*	33	*	31	*	63	35	56	42	43	36	160	69
22							-	-	42	*	*	*	31	*	33	*	38	30	56	42	42	35	230	69
23							33	*	*	*	*	*	31	*	33	*	34	*	58	42	40	34	150	71
24							34	*	*	*	31	*	31	*	33	30	32	*	56	44	39	34	100	69
25							32	*	*	*	32	*	33	*	35	30	32	*	96	44	39	35	76	46
26							*	*	30	*	33	*	33	30	33	*	32	*	69	42	40	36	46	36
27							*	*	*	*	33	*	33	30	33	30	33	*	50	39	40	36	44	35
28							*	*	*	*	40	*	36	*	34	29	33	*	46	38	41	36	45	34
29							*	*	*	*	38	*	38	30	34	30	32	*	44	37	49	38	44	31
30							30	*	*	*	30	*	39	30	34	30	33	*	44	35	63	40	40	30
31							*	*			*	*			34	*	34	*			94	41		

Table 19. - Daily maximum and minimum chloride concentrations, Delaware River at Chester, Pa ., in milligrams per liter
December 1, 1990 to November 30, 1991. Collection and analysis by Scott Paper Company.
{A dash (-) indicates missing data; * indicates less than 30 mg/L (milligrams per liter);
max is maximum value; min is minimum value}

Day	December		January		February		March		April		May		June		July		August		September		October		November	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	*	*	35	*	43	37	34	*	36	*	32	*	40	36	92	55	80	52	115	65	162	85	460	290
2	*	*	37	*	40	34	33	*	38	*	35	*	37	30	90	75	70	52	122	65	160	90	420	230
3	*	*	32	*	37	36	32	*	42	*	30	*	42	30	100	63	65	52	110	70	160	100	580	168
4	*	*	33	*	38	34	33	*	47	*	*	*	42	*	102	52	90	55	115	65	175	100	550	250
5	31	*	32	*	40	38	39	*	40	*	*	*	44	31	112	48	125	61	122	80	150	90	300	176
6	*	*	30	*	44	37	32	*	35	*	*	*	44	*	126	54	170	62	200	85	195	90	480	38
7	*	*	30	*	41	34	*	*	31	*	30	*	47	32	110	60	180	62	180	74	144	92	326	217
8	*	*	35	*	49	38	*	*	32	*	*	*	45	36	140	55	160	88	270	108	240	95	680	220
9	*	*	47	*	47	35	*	*	38	*	31	*	39	35	115	63	140	75	230	110	230	96	400	220
10	*	*	54	38	45	36	*	*	40	*	*	*	40	34	140	53	80	60	215	87	310	98	735	410
11	32	*	55	36	-	-	*	*	40	*	35	*	45	32	110	65	87	51	212	87	300	107	650	410
12	*	*	60	40	52	34	*	*	36	*	32	*	46	*	110	84	83	57	360	115	300	117	750	250
13	*	*	-	-	45	*	*	*	44	*	*	*	40	37	120	48	98	59	335	153	315	127	808	320
14	*	*	62	52	51	30	37	*	45	*	*	*	46	35	66	45	95	59	322	144	300	117	700	308
15	*	*	57	50	54	33	*	*	31	*	39	*	48	*	62	50	100	57	260	220	280	128	750	350
16	*	*	56	50	33	*	31	*	-	-	46	*	49	41	68	49	115	60	272	210	250	104	620	310
17	*	*	59	45	30	*	*	*	32	*	46	*	72	42	70	50	112	68	480	62	198	110	790	455
18	*	*	47	42	*	*	*	*	44	*	*	*	82	40	65	47	126	78	390	142	187	95	500	250
19	*	*	47	44	32	*	30	*	45	*	44	*	61	31	101	60	113	81	262	145	175	120	750	250
20	*	*	45	30	34	*	42	30	35	30	45	*	50	39	72	50	105	64	274	138	126	73	690	250
21	*	*	42	35	46	*	42	*	38	*	44	*	48	38	79	58	72	50	365	142	137	72	870	250
22	36	*	41	35	36	*	42	*	*	*	31	*	-	-	103	48	59	50	336	131	132	72	1080	340
23	33	*	42	36	35	*	43	*	34	*	34	*	64	50	89	40	65	60	310	130	139	73	746	250
24	*	*	40	35	30	*	42	*	42	*	42	*	58	44	82	43	70	56	320	125	164	74	500	250
25	*	*	40	32	30	*	38	*	40	*	30	*	56	40	92	46	90	50	258	130	223	78	250	125
26	*	*	44	*	30	*	36	*	-	-	45	30	58	46	92	52	85	64	165	92	80	74	150	80
27	*	*	39	34	-	-	40	*	-	-	44	35	62	35	65	50	84	64	157	85	250	75	150	90
28	*	*	42	36	30	*	32	*	37	*	44	32	63	33	72	46	74	65	171	96	313	84	134	85
29	30	*	42	35			38	*	43	*	42	34	92	51	70	60	84	52	130	100	567	100	118	60
30	31	*	42	36			45	31	44	*	43	30	78	*	78	60	120	60	130	100	400	180	98	55
31	35	*	41	*			44	*			44	*			70	55	105	66			340	178		

Table 20 - Daily maximum and minimum chloride concentrations, Delaware River at Reedy Island Jetty, Del. , in milligrams per liter
December 1, 1990 to November 30, 1991.

{A dash (-) indicates missing data; *indicates less than 30 mg/l (milligrams per liter); max is maximum value; min is minimum value}

Day	December		January		February		March		April		May		June		July		August		September		October		November	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	5600	1700	-	-	640	180	-	-	2700	490	2300	430	4000	1300	6300	2800	-	-	6800	3100	-	-	9900	6100
2	4700	1500	-	-	1400	180	-	-	2100	410	2000	410	3900	1200	6000	3000	-	-	6700	3400	-	-	9000	6500
3	5800	1600	-	-	810	170	-	-	2200	370	2100	420	4500	1400	5500	3100	5900	3000	6300	3400	-	-	8000	5900
4	5100	1800	-	-	690	160	-	-	2100	340	2600	440	4500	1700	-	-	5900	3100	6100	3000	5900	3100	8100	5700
5	2900	530	-	-	1900	170	-	-	1400	340	3300	530	5800	2400	-	-	6400	3100	6300	2900	6000	3200	8600	5700
6	2700	440	-	-	2100	240	1100	290	1600	310	-	-	5500	2400	-	-	6500	3000	6600	3200	5200	3200	8600	5700
7	2100	320	-	-	2800	270	970	87	2100	380	-	-	6000	2400	-	-	6600	3100	6500	2800	5700	3100	8800	5800
8	2000	270	-	-	3100	420	690	38	2400	340	-	-	6300	2600	-	-	6900	3100	6800	3400	6300	1300	8900	6000
9	2200	230	-	-	3000	700	2500	*	3100	540	-	-	6800	2500	-	-	6800	3500	6400	3400	5800	3200	9600	6700
10	2300	190	-	-	3900	780	3500	580	3600	580	-	-	6900	2700	-	-	6400	2900	6400	3700	6000	3200	11000	8000
11	2200	160	2700	670	4700	850	5100	1600	3300	570	-	-	6200	2800	-	-	6200	2800	5900	3600	6400	3400	12000	7500
12	2900	420	4100	1100	4600	900	6400	2900	3800	710	-	-	6300	2700	6400	3100	6100	2800	6500	3300	6000	3300	10000	7400
13	3100	520	3100	700	5400	1400	6600	3600	3900	1000	-	-	6400	2700	6300	3000	5600	2800	6500	3500	6000	3300	11000	7500
14	2500	390	3700	550	-	-	7700	4100	-	-	-	-	5900	2700	5800	2700	-	-	5900	3700	6000	3400	10000	7000
15	3500	460	3500	690	-	-	7300	3900	-	-	3800	890	6300	2800	5400	2500	-	-	6400	3600	6400	3600	10000	6900
16	2800	410	-	-	-	-	6900	3600	-	-	3900	890	5900	2900	4900	2400	-	-	5900	3500	6600	3600	9800	7100
17	2600	300	-	-	-	-	6800	3100	-	-	3400	960	5600	3000	4400	2600	-	-	5600	3200	7100	4000	10000	6800
18	3000	460	-	-	-	-	6000	3200	-	-	2700	920	5500	750	4300	2400	-	-	6600	3100	7700	3700	11000	7300
19	1700	260	-	-	-	-	5900	2800	-	-	3500	960	5300	2600	4500	2300	-	-	5500	3300	7600	3700	9800	7100
20	2500	270	-	-	-	-	5200	2400	3900	1500	2500	1000	5600	2700	4600	2200	-	-	7100	3200	7900	4000	9900	6900
21	2200	280	-	-	-	-	4900	2100	3900	1600	2200	950	5800	2500	5000	2300	-	-	6700	3600	8200	4100	9600	6400
22	1800	260	-	-	-	-	4500	1900	3900	1400	2200	850	6200	2900	5500	2300	-	-	6300	3500	7600	4300	9700	6500
23	1100	200	-	-	2500	400	5000	2000	3400	1100	3200	800	6800	3100	5700	2500	6100	2600	6800	3800	7400	4500	9300	6400
24	-	-	-	-	3000	410	4500	1600	2500	960	3000	970	6100	3000	6200	700	6200	2600	6300	3700	7700	4300	9900	6000
25	-	-	-	-	3300	560	3700	1500	2500	610	2800	720	6000	3000	6100	2800	5900	3100	6700	3600	7800	4500	7800	5300
26	-	-	-	-	3600	650	4100	1200	2300	540	3200	640	5900	3000	5800	2700	6500	3000	6500	3500	7500	4200	7000	4600
27	-	-	-	-	3300	600	3800	1000	1600	430	3200	820	5800	2900	5300	2700	5600	3000	6200	3400	7600	4400	7700	4500
28	-	-	-	-	3000	650	2800	800	2200	420	3200	830	5500	3800	5700	2700	5400	3200	6100	3300	7800	4600	7100	4500
29	-	-	-	-			2600	710	2600	470	3200	830	5700	2600	5900	3100	5600	2900	-	-	8900	5100	6100	4100
30	-	-	3100	390			2600	640	2200	440	3500	950	5500	2900	5900	2900	6200	2900	-	-	9300	5300	6900	4000
31	-	-	1800	380			3100	470			3800	1100			-	-	6000	3200			10000	6400		

Table 21. - Dissolved oxygen, Delaware River at Benjamin Franklin Bridge at Philadelphia, Pa.
Daily mean dissolved oxygen in milligrams per liter
December 1, 1990 to November 30, 1991.
{Monitor was not in operation December 1,1990 to March 4,1991; a dash (-) indicates missing data}

Day	December	January	February	March	April	May	June	July	August	September	October	November
1					11.0	8.3	3.9	4.3	2.5	4.7	5.0	7.0
2					10.7	8.1	4.1	4.1	2.9	4.9	5.1	7.0
3					10.7	8.0	4.2	3.8	3.2	5.1	5.1	7.2
4					10.6	7.9	4.6	3.6	3.4	5.1	5.0	7.5
5				11.8	10.6	7.8	-	3.7	3.7	5.0	5.0	7.6
6				11.2	10.5	7.6	-	3.5	4.1	4.8	5.1	7.7
7				10.1	10.4	7.0	4.8	3.3	4.1	4.6	5.1	7.7
8				11.0	10.2	6.9	5.0	3.2	4.0	4.5	5.3	7.8
9				11.6	10.1	6.9	5.2	3.2	4.1	4.5	5.5	8.0
10				11.6	10.1	6.7	5.1	3.3	3.6	4.5	5.5	8.5
11				12.0	-	6.6	5.1	3.5	3.2	4.3	5.5	8.6
12				12.1	10.2	6.7	4.8	3.6	3.2	4.4	5.3	8.7
13				12.2	9.9	7.0	4.7	3.9	3.2	4.6	-	8.8
14				12.3	9.7	6.7	4.7	3.6	3.3	4.4	5.3	8.8
15				12.2	9.3	6.8	4.6	3.3	3.4	4.2	5.3	8.8
16				12.3	8.8	7.1	4.5	3.3	3.4	4.1	5.1	8.9
17				12.4	8.3	7.6	4.1	3.5	3.5	4.1	5.5	9.2
18				12.2	8.2	7.9	4.2	-	3.9	4.2	5.8	9.0
19				12.1	8.0	8.3	3.7	-	4.0	4.3	5.8	9.1
20				12.1	8.2	8.6	3.2	-	3.9	4.4	6.3	9.3
21				12.1	8.3	8.7	3.0	-	3.6	4.5	6.3	9.1
22				12.0	8.5	8.5	3.1	4.5	3.5	4.7	6.2	-
23				11.7	8.7	8.7	3.4	4.3	3.7	4.7	6.3	8.1
24				11.3	8.8	8.2	3.4	4.2	3.9	4.7	6.3	-
25				11.2	8.7	7.8	3.4	4.0	4.2	4.6	6.2	8.8
26				-	9.0	7.4	3.6	3.5	4.4	4.3	6.0	9.3
27				-	9.0	6.8	3.8	3.0	4.3	4.3	5.9	9.0
28				10.7	8.9	5.9	4.1	2.7	4.5	4.5	6.0	8.9
29				11.1	8.8	5.3	4.3	2.6	4.3	4.7	6.5	8.6
30				11.2	8.6	4.6	4.3	2.6	4.2	5.0	6.6	8.5
31				11.2		4.1		2.5	4.2		6.8	

Table 22. - Dissolved oxygen, Delaware River at Chester, Pa.
Daily mean dissolved oxygen in milligrams per liter
December 1, 1990 to November 30, 1991.
{Monitor was not in operation December 1,1990 to March 4,1991; a dash (-) indicates missing data}

Day	December	January	February	March	April	May	June	July	August	September	October	November
1					10.5	8.9	5.2	5.8	5.1	6.2	5.9	7.5
2					10.7	9.0	5.2	5.7	5.3	6.3	6.1	7.4
3					10.6	9.0	5.2	5.5	5.3	6.2	6.1	7.3
4					10.3	9.2	5.5	5.2	5.4	6.2	6.0	7.3
5				10.4	10.0	9.2	5.7	5.4	5.5	6.1	5.9	7.4
6				9.8	9.7	8.8	5.9	5.0	5.7	5.7	5.9	7.6
7				9.5	7.4	8.1	6.2	5.1	5.7	5.5	5.8	7.7
8				9.7	8.1	7.5	6.4	5.1	5.7	5.3	6.0	7.8
9				9.6	8.6	6.6	6.2	5.1	5.7	5.2	6.3	8.0
10				9.5	8.3	7.9	6.0	5.2	5.5	5.3	6.5	8.5
11				9.6	8.3	8.6	6.0	5.4	5.2	5.3	6.5	8.9
12				9.7	9.2	8.7	6.1	5.6	5.5	5.2	6.3	8.9
13				9.8	9.5	8.8	6.0	5.5	5.7	5.3	6.3	8.9
14				9.9	9.6	9.1	5.8	5.1	5.4	5.2	6.4	8.9
15				9.9	9.6	9.1	5.4	4.7	5.4	5.2	6.5	8.9
16				10.0	-	9.1	5.4	4.9	5.4	5.2	6.4	8.8
17				10.0	-	8.9	5.2	5.2	5.6	5.2	6.7	8.8
18				9.9	9.0	8.5	5.4	5.8	5.9	5.2	6.8	8.9
19				10.0	9.1	8.3	5.3	5.7	5.8	5.3	6.8	8.9
20				10.1	9.3	8.2	5.1	5.7	5.4	5.4	6.6	8.8
21				10.0	9.3	8.2	5.1	5.6	5.3	5.6	6.6	8.7
22				10.3	9.3	8.0	5.0	5.4	5.3	5.8	6.7	8.5
23				10.7	9.3	7.7	5.3	5.3	5.6	5.9	6.6	8.4
24				10.6	9.2	7.4	5.5	5.3	5.7	6.0	6.5	8.3
25				10.6	9.1	7.2	5.6	5.0	6.3	6.0	6.4	8.3
26				10.5	9.2	6.7	5.7	5.0	6.3	5.7	6.2	8.3
27				10.4	9.3	6.5	5.8	5.1	6.5	5.5	6.2	8.4
28				10.2	9.2	6.2	5.9	4.9	6.5	5.4	6.3	8.4
29				10.1	9.2	5.8	5.8	5.0	6.3	5.5	6.7	8.3
30				10.2	9.0	5.4	5.8	5.1	6.2	5.7	7.0	8.4
31				10.3		5.4		5.0	6.1		7.4	

Figure 7 shows the frequency of hourly dissolved-oxygen concentration at Benjamin Franklin Bridge and Chester during the critical summer period, July through September, 1991. At Chester, dissolved-oxygen concentration was never equal to or below 4 mg/L in 1991 as compared to 4 percent of the time in 1990, and 8 percent of the time in 1989. At Benjamin Franklin Bridge, the dissolved-oxygen concentration was equal to or below 4 mg/L 51 percent of the time in 1991 as compared with 9 percent of the time in 1990 and 70 percent of the time in 1989.

Hydrogen-Ion Concentration (pH)

Hydrogen-ion concentration (pH) is fundamentally a measure of acidity or alkalinity. Values of pH below 7 indicate acidity, whereas values above 7 indicate alkalinity. In natural waters, pH generally ranges from 6.0 to 8.5. The main factors controlling the pH of a body of water are usually the geochemistry of the drainage basin and external influences such as pollution. Photosynthetic activity can also have a considerable influence on pH values. Increased photosynthetic activity (algal bloom) produces higher pH values. All pH values at Benjamin Franklin Bridge, Chester, and Reedy Island Jetty were in a range of 6.4 to 8.2. The pH range for each station is: Reedy Island Jetty, 7.1 to 8.2; Chester, 6.5 to 7.4; Benjamin Franklin Bridge, 6.4 to 7.8. The pH in the estuary tends to be lowest near Trenton, N.J., and to increase downstream.

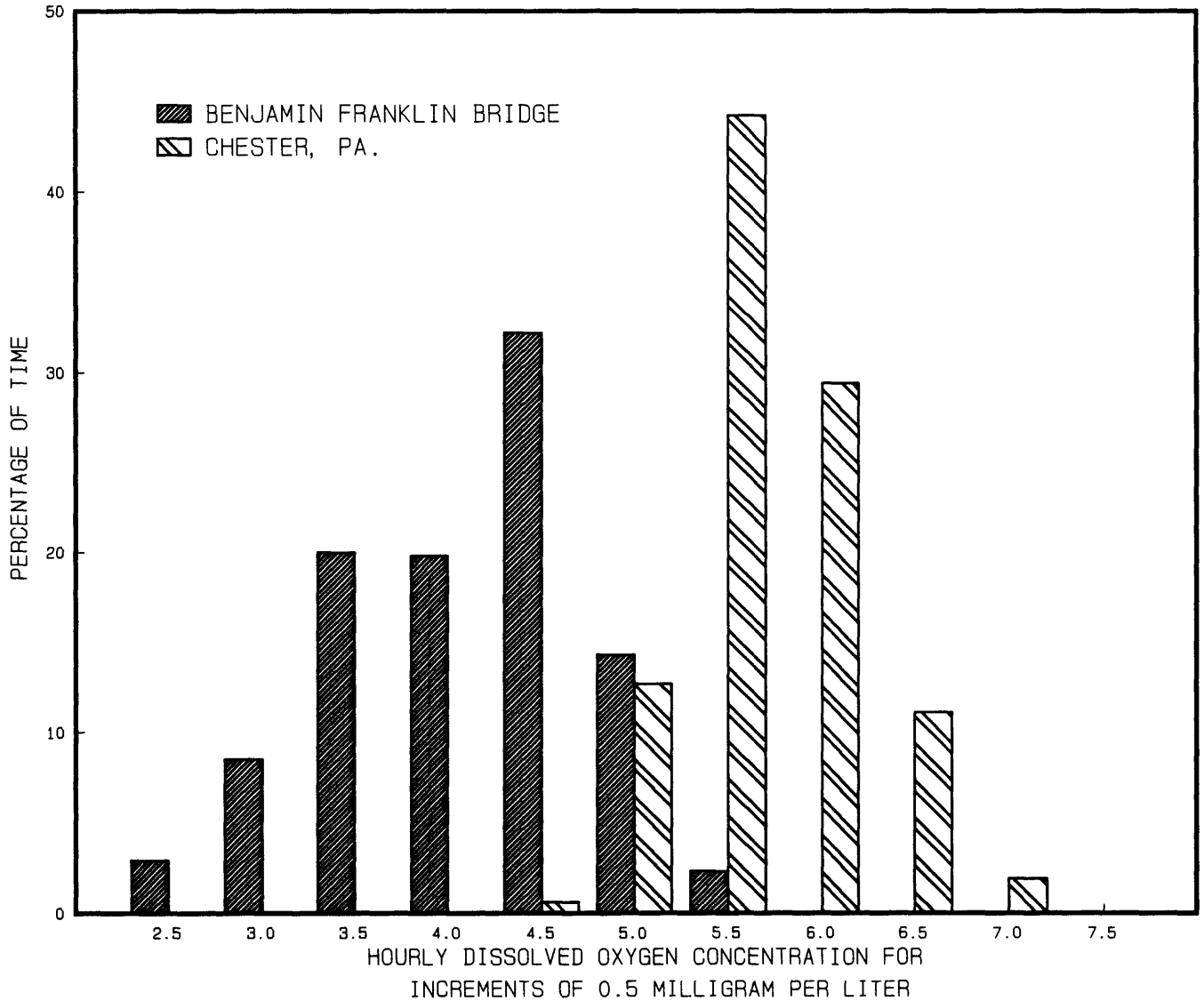

Figure 7.- Frequency of occurance of dissolved-oxygen concentrations at two stations in the Delaware River, during July, August and September 1991.